FINAL REPORT 1994

Small Mammal Surveys of Selected Sites at the National Training Center, Fort Irwin, California

Submitted to:

U.S. Army
National Training Center
Fort Irwin, CA 92310-5000

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DISCLAIMER

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INTRODUCTION

The U.S. Army instituted the Integrated Training Area Management (ITAM) program to monitor ecosystems within U.S. Army training areas. The National Training Center (NTC) at Ft. Irwin began the Land Condition Trend Analysis (LCTA) to comply with the ITAM and assess conditions on the post. The LCTA program, which included biodiversity surveys, was modified to include studies of disturbed sites to better serve the needs of the post.

Among the biodiversity surveys, conducted as part of a larger resource inventory, were surveys of small mammal species. The purposes of these surveys are to determine the small mammal species diversity and abundance at selected undisturbed sites and the impacts of training at a selected disturbed site at the National Training Center, Ft Irwin. Additional trapping will be conducted at the Goldstone Lake site to monitor a population of the Mohave ground squirrel, *Spermophilus mohavensis*, a California state-listed species.

This report provides the following: 1. Small mammal species diversity and abundance data collected at selected sites trapped during 1994; 2. A comparison of the small mammal species diversity and abundance data collected at selected sites trapped during 1994 to the 1993 data taken from the same sites; 3. Compares species abundance and diversity data from a training impacted site to a matched similar untrained site at the National Training Center, Ft Irwin.

MATERIALS AND METHODS

Trap Organization and Site Selection

Trap organization and site selection is based on the the trap unit and trap grid sites. Each trap unit was composed of three or four trap grids. The trap unit is a name that designates the region being studied: For example; Bitter Springs, Goldstone, Granite Mountains, and Avawatz Mountains are unit names corresponding to specific regions of the base.

The trap grid name is an acronym based on the area *or* the unit and characteristic (vegetation, soil, etc.) of the grid site that is being trapped. An example of an area-named grid would be Lake grid (at the north end of Goldstone Lake), whereas, an example of the unit and characteristic-named grid would be Gracre (Granite Mountains creosote).

The sites at which the trap grids were placed were selected by visuallyinspecting habitat types and choosing those sites, based on floral and geological characteristics (sediment type, slope angle, and orientation), which were felt to be most representative of the area. The grids were placed within vegetation types.

Grid Layout

Each trapping grid consisted of 100 Sherman™ 3.5"H x 3"W x 12"L folding aluminum live-traps arranged in four parallel rows with each row 25 meters apart. Each of the traps in each of the rows was spaced at 25 meters. The rows of each grid were designated A, B, C, and D and the trap stations were numbered 1 through 25. Each trapping grid measured approximately 600 x 75 meters and enclosed an area of approximately 4.5 hectares.

At most trapsites a 25 cm wide by 50 cm long by 5 cm deep depression was excavated. Fitted to this depression was a 50 by 60 cm corrugated 200 Lb strength cardboard which had been folded along its short axis to form an equal-sided "A" frame shelter. On rocky slopes, where excavation was not possible, cardboard shelters were fitted among the stones and cobbles. Galvanized nails, 18 cm in length, were hammered through the cardboard "A" frame shelters midway along the bottom and 2.5 cm in from the edge of the cardboard to anchor them securely to the ground. The excavated soil or stones were placed along the sides at the bottom of the shelter and tamped down for added security. The trap was placed in the center of the shelter.

A small mound of soil or a rock placed at each open end of the shelter prevented captured animal's movements or ravens from moving the trap out of the shelter and into the sun. Pink surveyor's flagging on the nearest bush marked the location of the traps.

Trapping Protocol

All grids were prebaited for 1 day using a mixture of bird seed and peanut butter. The bait mixture was placed in line [(forming a large plus (+) with the trap at its center)] for approximately 2 meters from the trap. The traps were opened for captures and baited at the end of the prebait day at sunset. Trapping continued for five days closing at sunset of the fifth day. The traps were checked each morning from 05:00 to 07:30 hours, each noon period from approximately 11:00 to 13:00 hours (depending on the ambient temperature), and again around sunset (18:30 to 20:00 hours).

The State of California trapping protocol for the Mohave ground squirrel requires that the traps be closed at a shelter shade temperature of 32° C to prevent heat stress from killing the squirrels. The lethal limit for this squirrel is about 40°C. The temperature of the traps in the shade of the cardboard shelters was monitored throughout the day using a liquid-filled glass bulb thermometer.

Treatment of Captures

Captured animals were removed from the traps and placed in Ziplock™ bags for safe handling while species, sex, reproductive condition, age, and capture status (new or recaptured) were determined. Mohave ground squirrels were weighed and marked on the venter and rump using a permanent Marvy™ fabric marker. All other captures were fur clipped with moustache trimmers on the left hip for males and on the right hip for females prior to release. Great Basin/Chisel-Toothed kangaroo rats, *Dipodomys microps*, were also fur clipped on the center of the back.

Field notes include date, trapping period (time), unit number, grid number, trap row and number, and the sex, reproductive condition, age, capture status, and weight (where applicable) of the species captured.

Grid Descriptions and Deployment Dates

Four units were trapped in 1994: Bitter Springs [trapped from May 24 and 26 through 29 (interruption due to sand storm)], Goldstone (trapped from June 6 through June 10), Granite Mountains [trapped from June 20 through 23 and July 3 (interruption due to live fire scheduling error)], and Avawatz Mountains (trapped from June 29 through July 3). Lake grid was also trapped during the Granite Mountains and Avawatz Units to assess the Mohave ground squirrel population of this site. Maps of the grid locations (determined by the NavStar GPS) are in Appendix A.

Bitter Springs Unit - Grids Bsalk, Bsdun, and Bscre, Bsdcre.

Bsalk grid (Bitter Springs Alkaline), oriented E-NE--W-SW, was located on the southeastern portion of the base in the Bitter Springs area (Lat. 35° 13' 34.5"N, Lon. 116° 25' 58.0"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 282 m. This site had a gentle to moderate east-northeast facing slope with a sandy alkali soil covered with 2-5 mm gravels with 5% of them to 50 mm in size (mostly at the western-southwestern upper end). There were surface undulations suggesting sheet flow (runoff). The vegetation is dominated by a Saltbush community, *Atriplex sp.*

Bsdun grid (Bitter Springs Dune), oriented E-W, was located on the southeastern portion of the base north of a basaltic lava mount, locally called "the Whale," and just west of the Bitter Springs area (Lat. 35° 13' 50.5"N, Lon. 116° 26' 04.1"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 365 m. This site was composed of a series of undulating hillocks of aeolian sands with <1% coverage by gravels. The vegetation is dominated by a Saltbush, *Atriplex sp.*, and Russian Thistle, *Salsola sp.*

Bscre grid (Bitter Springs Creosote), oriented E-W, was located on the southeastern portion of the base east of the Bitter Springs area (Lat. 35° 12' 41.8"N, Lon. 116° 24' 42.8"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 199 m. This site was relatively flat with a gentle western facing slope. The surface was sandy with small patches of aeolian sands, and small incipient dunes (5% coverage) were forming at the southern edge. The surface at the east end had gravels up to 50 mm in size with a coverage of approximately 20%. The western end had gravels to about 20 mm in size with an approximate coverage of 5%. The vegetation is dominated by Creosote bushes, *Larrea divaricata*, and Burro-Weed, *Ambrosia dumosa.*

Bsdcre Grid (Bitter Springs Disturbed Creosote), oriented N-NE--S-SW, was located on the southeastern portion of the base northeast of the Bitter Springs area but south of Silver Springs Road (Lat. 35° 15' 24.3"N, Lon. 116° 23' 14.2"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 541 m. This site was relatively flat with a gentle western facing slope. The surface was very sandy (just short of incipient dune formation) from training and from aeolian sediments which had drifted in from nearby training areas. Interspersed among the sands were coarse gravels to about 20 mm in size which covered approximately 8% of the site. There were moderately numerous vehicle tracks and occasional crushed Creosote bushes. The vegetation was dominated by Creosote Bushes: They were much smaller in size, however, when compared to those of Bscre Grid.

Goldstone Unit - Grids Lake, Pion, Morok, and Mocre.
These sites were located in the Goldstone Deep Space Communications Complex. Lake grid (Goldstone Lake), oriented E-SE--W-NW, was at the north end of Goldstone Lake (Lat. 35° 23' 12.3"N, Lon. 116° 54' 02.5"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 862 m. This site had a slight east-west slope with a sandy-loam over sandy-clay soil. This soil is covered with approximately 10% coarse gravels (2-25.4 mm) and less than 1% cobbles. The vegetation is dominated by the Saltbush species, *Atriplex confertifolia* and *A. polycarpa*, with Burro-Weed, *Ambrosia dumosa*, Golden head, *Acamptopappus sp.*, and a few Creosote bushes, *Larrea divaricata*.

Pion grid (Goldstone Pioneer Road), oriented SE-NW, was on the slope north of the junction of Goldstone Rd. and Pioneer Rd. (Lat. 35° 22' 08.8"N, Lon. 116° 51' 57.0"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 912 m. This site had a slight east-west slope with a gravelly sandy-loam soil. This soil was covered with approximately 60% coarse gravels (2-25.4 mm) with less than 1% cobbles. The vegetation is dominated by Creosote bush, *Larrea divaricata*, and Brome Grass, *Bromus*, with Goldenbush, *Haplopappus sp.*, Mormon Tea, *Ephedra sp.*, Buckwheat, *Eriogonum sp.*, and Fiddleneck, *Amsinckia sp.*

Morok grid (Goldstone Mohave Site Rock), oriented SE-NW, was a basaltic lava bench south of Goddard Rd. and east of the Mohave Station (between Apollo and Mohave Stations-Lat. 35° 20' 02.2"N, Lon. 116° 53' 00.0"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 924 m. This site had a moderate east-west slope with a gravelly sandy-loam soil. This soil was covered with approximately 50% coarse materials [(10% cobbles, 10% stones, and 30% gravels (2-25.4 mm)] with the rest being sand. The vegetation is composed of Creosote bush, *Larrea divaricata*, Burro-Weed, *Ambrosia dumosa*, Buckwheat, *Eriogonum fasciculatum*, Goldenhead, *Acamptopappus sp.*, Winter Fat, *Eurotia lanata*, Turpentine-Broom, *Thamnosma montana*, Rabbitbrush, *Chrysothamnus sp.*, and Brome Grass, *Bromus sp.*

Mocre grid (Goldstone Mohave Site Creosote), oriented N-S, was between the lava bench of Morok grid and Mohave Station, south of Goddard Rd. and just east of the Mohave Station (Lat. 35° 19' 58.6"N, Lon. 116° 53' 15.1"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 892 m. This site had a gentle N-S slope with a gravelly-loam sandy soil. This soil was covered with approximately 40% gravel materials (2-25.4 mm) and 1% cobbles with small patches of aeolian sands at the southern end. The vegetation is composed of Creosote bush, *Larrea divaricata*, Burro-Weed, *Ambrosia dumosa*, Buckwheat, *Eriogonum fasciculatum*, Goldenhead, *Acamptopappus sp.*, Boxthorn, *Lycium sp.*, Hop-Sage, *Grayia spinosa*, Brome Grass, *Bromus sp.*, and one Joshua tree, *Yucca brevifolia.*

Granite Mountains Unit - Grids Lake, Gracre, Grahym, and Grablb.
Lake grid (Goldstone Lake), see Goldstone Unit for the description.

Gracre grid (Granite Mountains Creosote), oriented NW-SE, was west of the southwestern portion of the Gary Owen impact area in the foothills of the Granite Mountains (Lat. 35° 30' 36.6"N, Lon. 116° 51' 56.3"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 1164 m. This site had a moderate northeast-southwest slope with a gravelly sandy-loam soil. This soil is covered with approximately 5% coarse gravels (2-25.4 mm) and less than 1% cobbles. The vegetation is dominated by Creosote bush, *Larrea divaricata* with Burro-Weed, *Ambrosia dumosa*, Mormon Tea, *Ephedra sp.*, and one Joshua tree, *Yucca brevifolia.*

Grahym grid (Granite Mountains Hymenoclea), oriented N-S, was located down the slope from Gracre grid (west of the southwestern portion of the Gary Owen impact area) in the foothills of the Granite Mountains (Lat. 35° 30' 45.2"N, Lon. 116° 51' 42.9"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 1134 m. This site had a slight northwest-southeast slope and is partially in a wash. The portion outside the wash has gravelly sandy-loam soils with approximately 5% coarse gravels (2-25.4 mm) and less than 1% cobbles. The portion within the wash has a 40%

coarse gravelly soil with 5% cobbles and less than 1% stones. The vegetation is dominated by Cheese Bush, *Hymenoclea salsola*, Senna, *Cassia sp.*, Mormon Tea, *Ephedra sp.*, Dalea, *Dalea sp.*, and at the north end of the grid, Creosote bush, *Larrea divaricata.*

Grablb grid (Granite Mountains Blackbush), oriented NE-SW, was located west of the southwestern corner of the Gary Owen impact area in the foothills of the Granite Mountains (Lat. 35° 31' 41.6"N, Lon. 116° 52' 00.9"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 1174 m. This site had a slight northeast-southwest slope with a sandy-loam soil covered with approximately 50% coarse gravels (2-25.4 mm) and less than 1% cobbles. The dominant vegetation is Blackbush, *Coleogyne ramosissima*, Creosote bush, *Larrea divaricata,* Goldenbush, *Acamptopappus sp.*, Mormon Tea, *Ephedra sp.*, with one Joshua tree, *Yucca brevifolia*, on the site. This site had been trained on since being trapped in 1993 as there were wheeled vehicle tracks on the grid.

Avawatz Mountains Unit - Grids Lake, Avjun, and Avcre.
Lake grid (Goldstone Lake), see Goldstone Unit for the description.

Avjun Grid (Avawatz Mountains Juniper), oriented E-NE--W-SW, was located in the western foothills of the Avawatz Mountains (Lat. 35° 30' 53.6"N, Lon. 116° 20' 43.0"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 1692 m. This site had moderately sloping terrain dissected by arroyos; slopes from 10 to 45 percent with incipient terraces in between. The soil is sandy and is overlain by gravels to 25.4 mm in some places forming an incipient pavement. The vegetation is dominated by the Saltbush group, *Atriplex*, with Burro-Weed, *Ambrosia dumosa*, Goldenhead, *Acamptopappus sp.*, and Junipers, *Juniperus sp.*, with very few creosote bushes.

Avcre (Avawatz Mountains Creosote), oriented E-W, was located in the western foothills of the Avawatz Mountains (Lat. 39° 25' 56.4"N, Lon. 116° 21' 16.9"W) at an elevation HAE (Height Above Elipsoid-Map Datum WGS-84) of 1457 m. This site was a moderately dissected upper bajada with dry stream channels oriented N-S producing an undulating topography. The sediments were coarse, fractured, poorly sorted gravels up to 25.4 mm. The stream channels consisted of coarse to fine sands. The vegetation is dominated by Creosote bushes, *Larrea divaricata*, Burro-Weed, *Ambrosia dumosa*, Goldenhead, *Acamptopappus sp.*, Saltbushes, *Atriplex* spp., with an occasional Joshua tree, *Yucca brevifolia*.

RESULTS

A total of 1362 new captures (of which 10 are captures of known species but of unidentified sex/age) and 2590 recaptures of 15 species were recorded from 13 different grids in 1994. Lake grid, containing the current largest population of Mohave ground squirrels discovered during this project, was additionally trapped while trapping the Granite Mountains and Avawatz Units. This additional trapping of the Mohave ground squirrel was conducted to determine the population size and demographics of this ground squirrel as part of a long term study of this sensitive species.

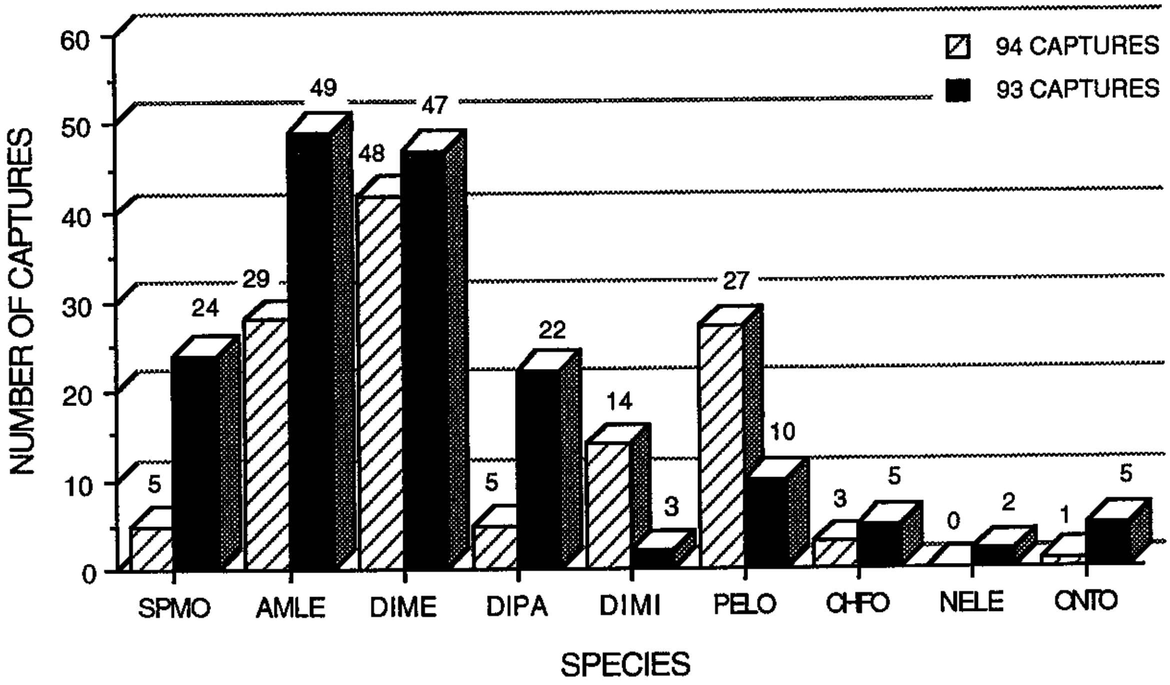
The new captures for each grid are given in the form of bar graphs and tables. Each bar graph has the numerical value for the new captures (for both 1994 and 1993) given above the bars of the graph (see Graphs 1-13). Small mammal species abundance are presented in Tables 1 (1994) and 2 (1993), respectively. Small mammal species demographics (age/sex) for 1994 are presented in Table 3. Mohave ground squirrel demographics (age/sex) for 1993 and 1994 are presented in Table 4.

The Tukey test, a multiple range test, was used to determine the difference in population means between individual species captured at grids comparatively trapped in 1993 and 1994 and the numerical difference of individual species trapped in 1994 at the Bscre (undisturbed) and the Bsdcre (disturbed) creosote grids. This test requires data for both years being compared or the test cannot be computed. Because of this reqiurement several grids could not be statistically tested (see Table 5). The 4-factor repeated measures ANOVA, presented as statistical tables in Appendix B, simultaneously compared year (1993-94), transect (trap row A, B, C, D), trap day (Day 1-Day 5), and species (new captures) for each grid.

Rain fall data, from the Bicycle Lake weather station, are presented in Table 6. The Bicycle Lake weather station is approximately centrally located in the southern third of the post and therefore does not represent actual rainfall measured on the grids. However, this is this only continuously recorded data available.

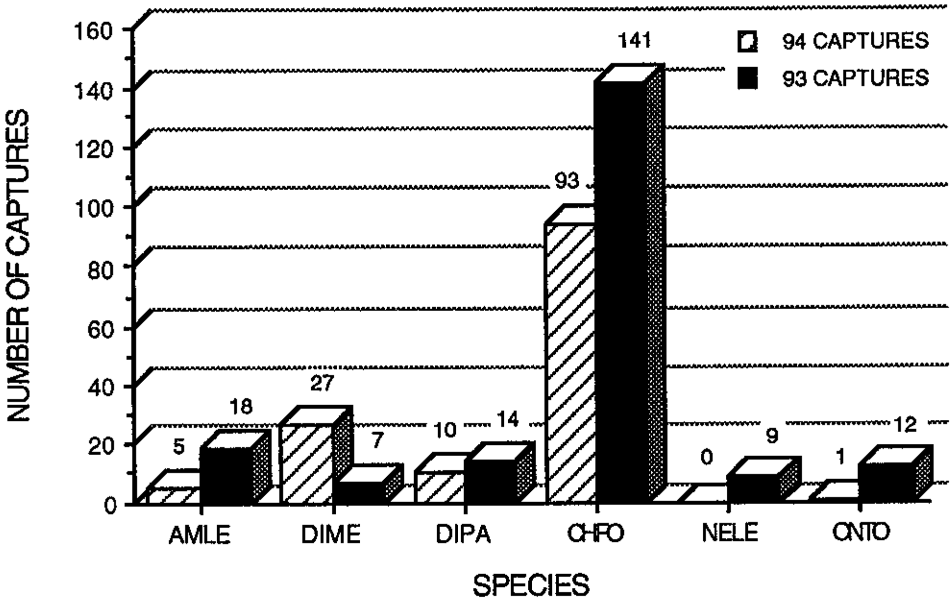
To facilitate graphical presentation of the names of the species, I used a code which combines the first two letters of the genus and the first two letters of the species. For example, the Antelope ground squirrel, *Ammospermophilus leucurus*, becomes AMLE. The code is presented on the bottom of each graph figure. Graph 1 begins on the following page with Table 1 following the graphs.

GRAPH 1. CAPTURES FROM GOLDSTONE UNIT LAKE GRID.



SPMO = *Spermophilus mohavensis* / Mohave ground squirrel
AMLE = *Ammospermophilus leucurus* / Antelope ground squirrel
SPTE = *Spermophilus tereticaudus* / Round-tailed ground squirrel
DIME = *Dipodomys merriami* / Merriam's kangaroo rat
DIPA = *Dipodomys panamintinus* / Panamint Kangaroo rat
DIMI = *Dipodomys microps* / Great Basin Kangaroo rat
DIDE = *Dipodomys deserti* / Desert kangaroo rat
PELO = *Perognathus longimembris* / Little pocket mouse
PEPE = *Perognathus penicillatus* / Desert pocket mouse
CHFO = *Chaetodipus formosus* / Long-tailed pocket mouse
NELE = *Neotoma lepida* / Desert woodrat
PEMA = *Peromyscus maniculatus* / Deer mouse
PEER = *Peromyscus eremicus* / Cactus mouse
PECR = *Peromyscus crinitus* / Canyon mouse
PEBO = *Peromyscus boylii* / Brush mouse
PETR = *Peromyscus truei* / Pinyon mouse
ONTO = *Onychomys torridus* / Grasshopper mouse
SYAU = *Sylvilagus audubonii* / Audubon cottontail

GRAPH 2. CAPTURES FROM GOLDSTONE UNIT PION GRID.



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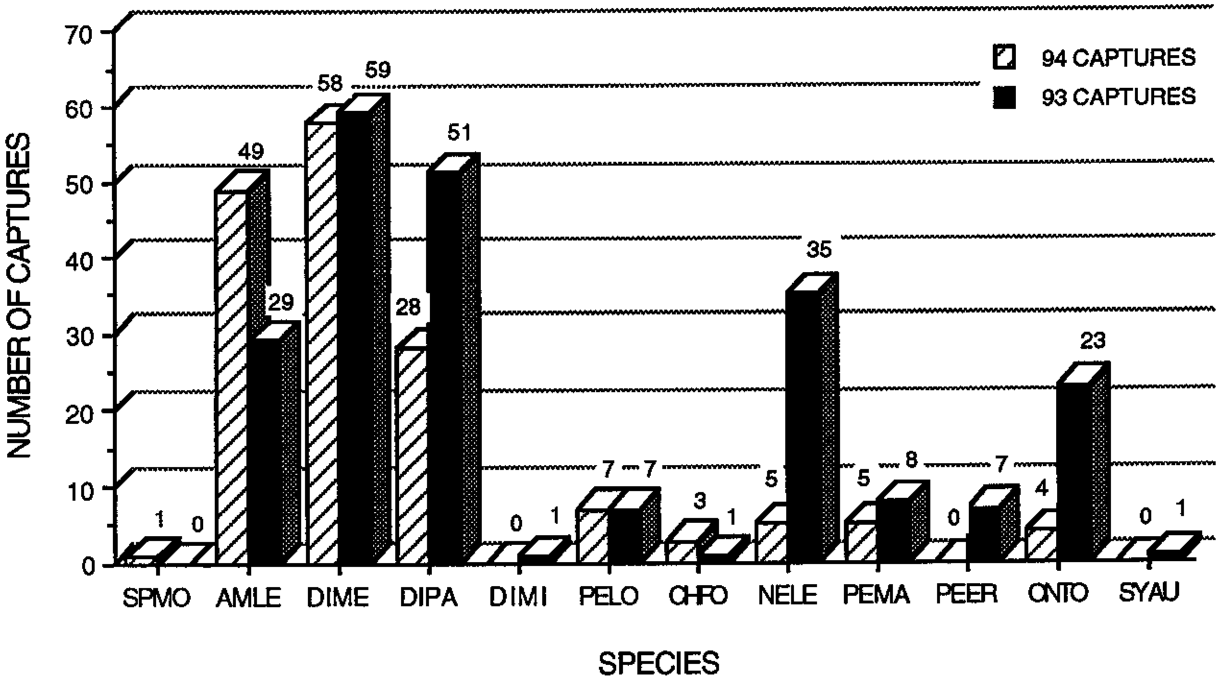
GRAPH 3. CAPTURES FROM GOLDSTONE UNIT MOCRE GRID.



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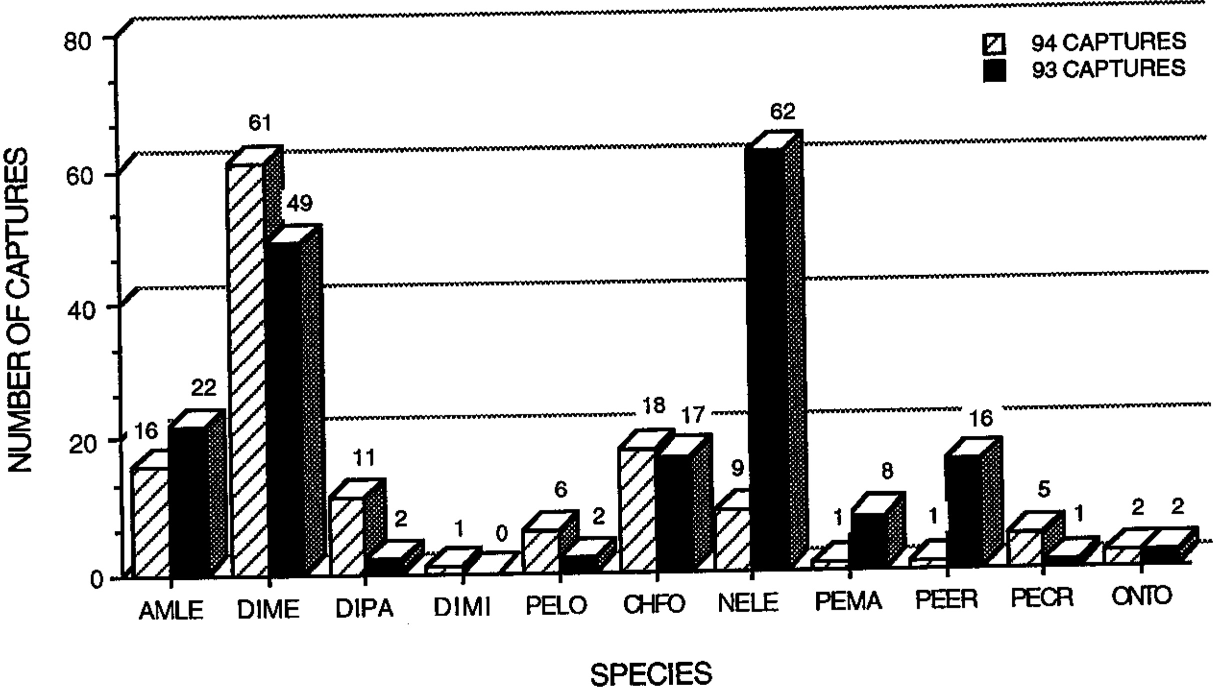
GRAPH 4. CAPTURES FROM GOLDSTONE UNIT MOROK GRID.



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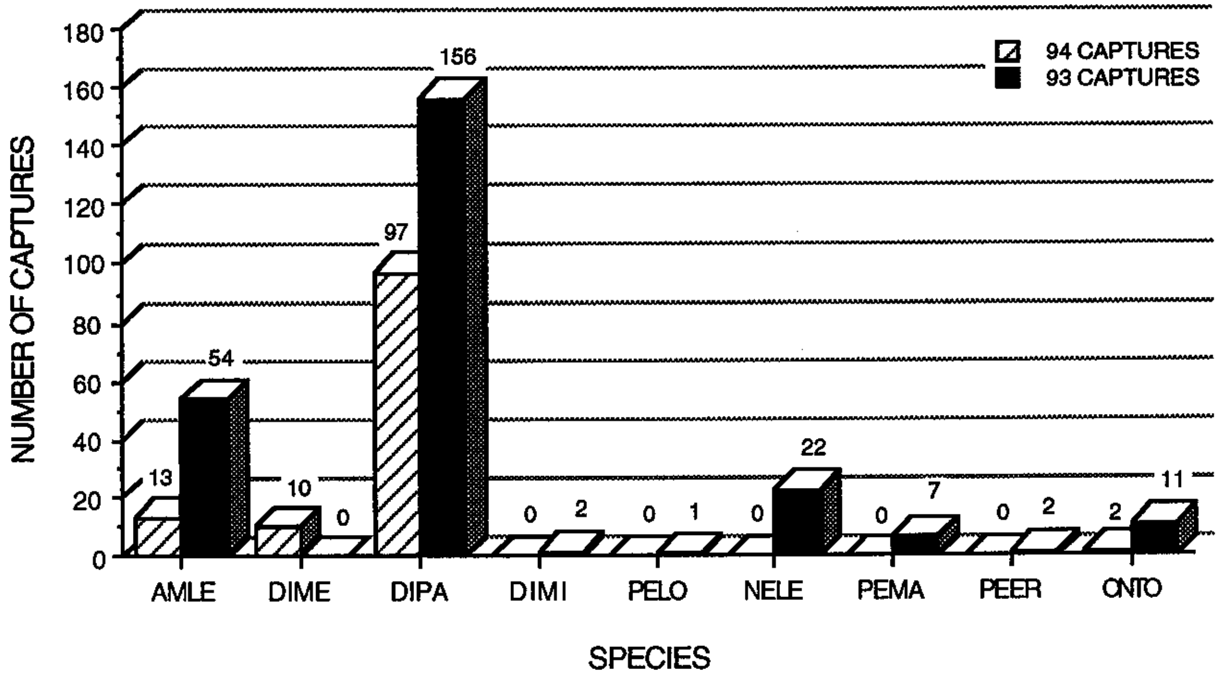
GRAPH 5. CAPTURES FROM GRANITE MOUNTAINS UNIT GRACRE GRID.



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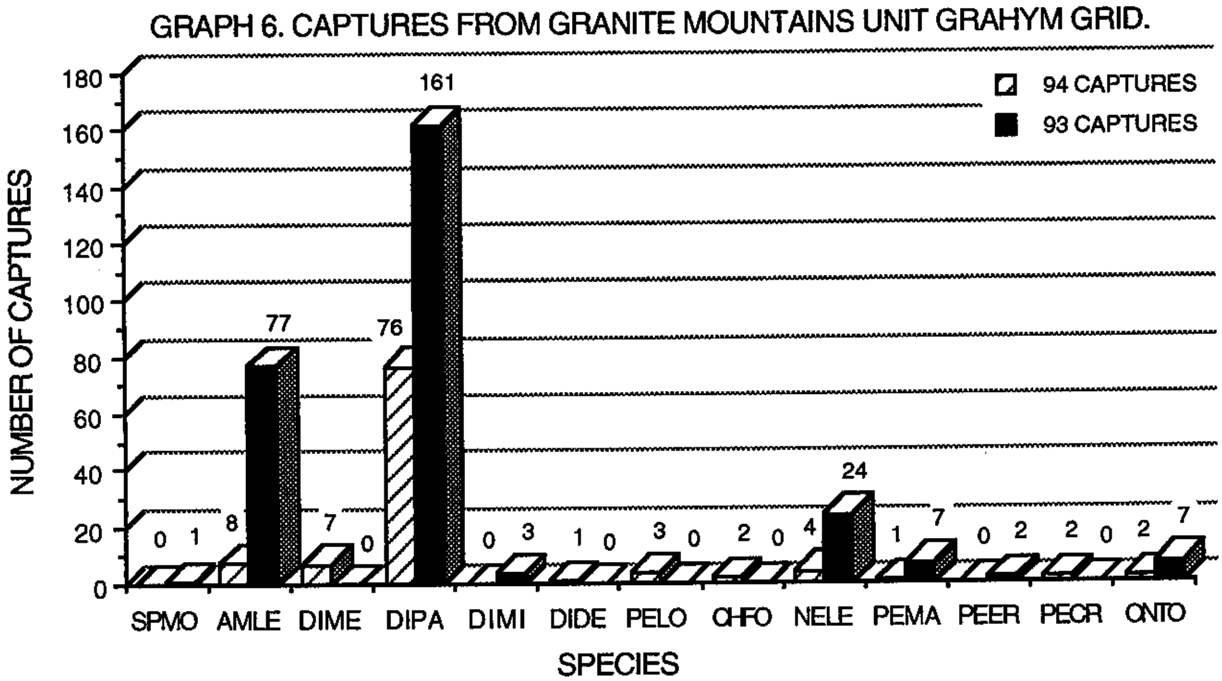

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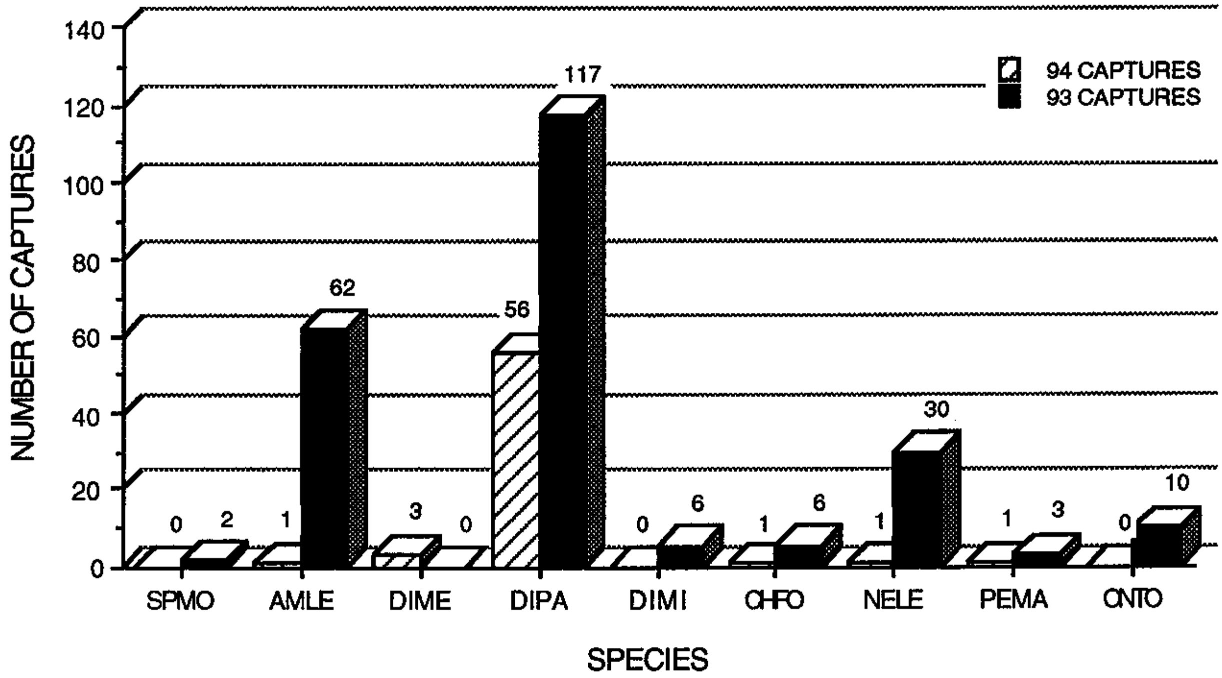
GRAPH 7. CAPTURES FROM GRANITE MOUNTAINS UNIT GRABLB GRID.



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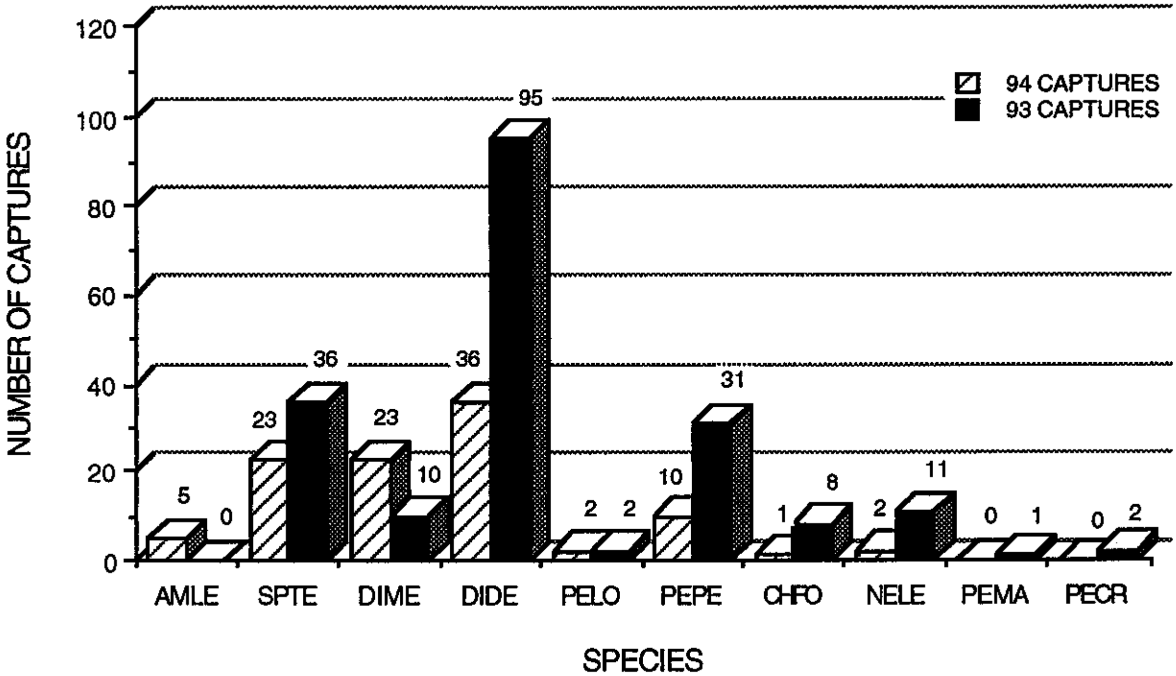
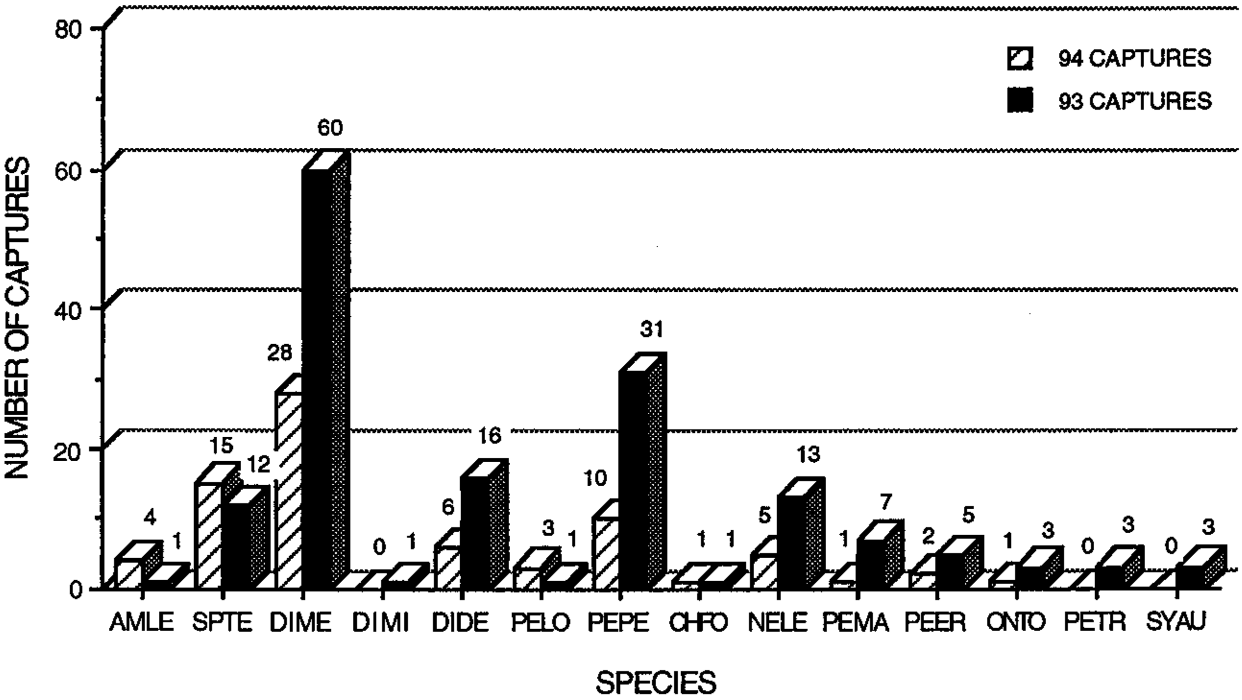
SPTE = *Spermophilus tereticaudus* / Round-tailed ground squirrel
DIME = *Dipodomys merriami* / Merriam's kangaroo rat
DIPA = *Dipodomys panamintinus* / Panamint Kangaroo rat
DIMI = *Dipodomys microps* / Great Basin Kangaroo rat
DIDE = *Dipodomys deserti* / Desert kangaroo rat
PELO = *Perognathus longimembris* / Little pocket mouse
PEPE = *Perognathus penicillatus* / Desert pocket mouse
CHFO = *Chaetodipus formosus* / Long-tailed pocket mouse
NELE = *Neotoma lepida* / Desert woodrat
PEMA = *Peromyscus maniculatus* / Deer mouse
PEER = *Peromyscus eremicus* / Cactus mouse
PECR = *Peromyscus crinitus* / Canyon mouse
PEBO = *Peromyscus boylii* / Brush mouse
PETR = *Peromyscus truei* / Pinyon mouse
ONTO = *Onychomys torridus* / Grasshopper mouse
SYAU = *Sylvilagus audubonii* / Audubon cottontail

GRAPH 8. CAPTURES FROM BITTER SPRINGS UNIT BSDUN GRID.



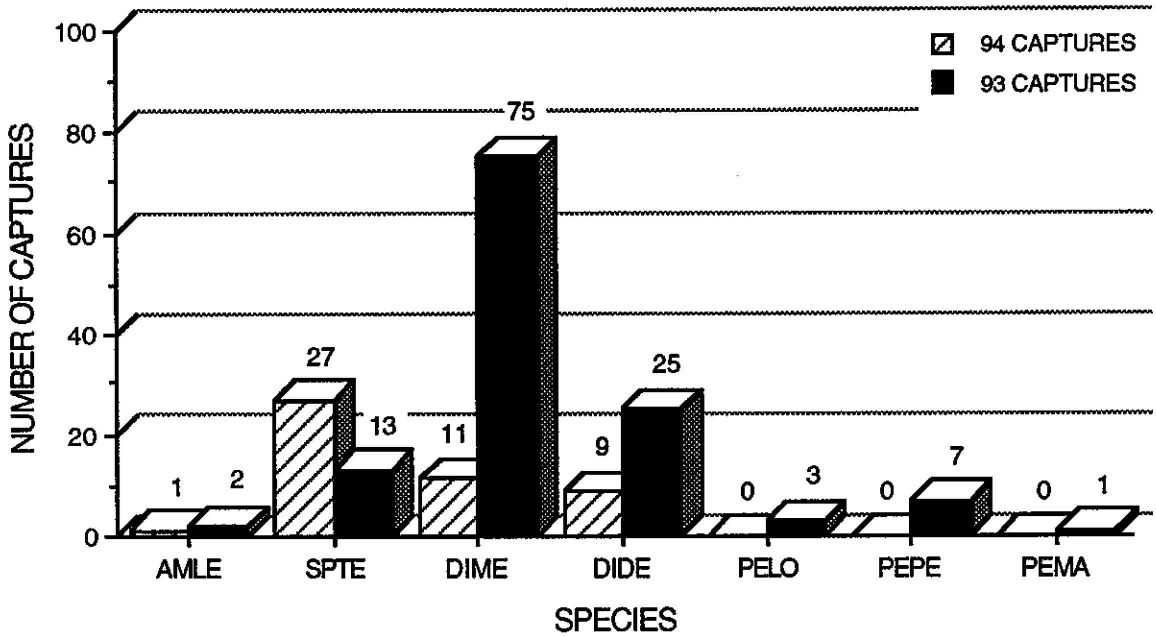
SPMO = *Spermophilus mohavensis* / Mohave ground squirrel
AMLE = *Ammospermophilus leucurus* / Antelope ground squirrel
SPTE = *Spermophilus tereticaudus* / Round-tailed ground squirrel
DIME = *Dipodomys merriami* / Merriam's kangaroo rat
DIPA = *Dipodomys panamintinus* / Panamint Kangaroo rat
DIMI = *Dipodomys microps* / Great Basin Kangaroo rat
DIDE = *Dipodomys deserti* / Desert kangaroo rat
PELO = *Perognathus longimembris* / Little pocket mouse
PEPE = *Perognathus penicillatus* / Desert pocket mouse
CHFO = *Chaetodipus formosus* / Long-tailed pocket mouse
NELE = *Neotoma lepida* / Desert woodrat
PEMA = *Peromyscus maniculatus* / Deer mouse
PEER = *Peromyscus eremicus* / Cactus mouse
PECR = *Peromyscus crinitus* / Canyon mouse
PEBO = *Peromyscus boylii* / Brush mouse
PETR = *Peromyscus truei* / Pinyon mouse
ONTO = *Onychomys torridus* / Grasshopper mouse
SYAU = *Sylvilagus audubonii* / Audubon cottontail

GRAPH 9. CAPTURES FROM BITTER SPRINGS UNIT BSALK GRID.



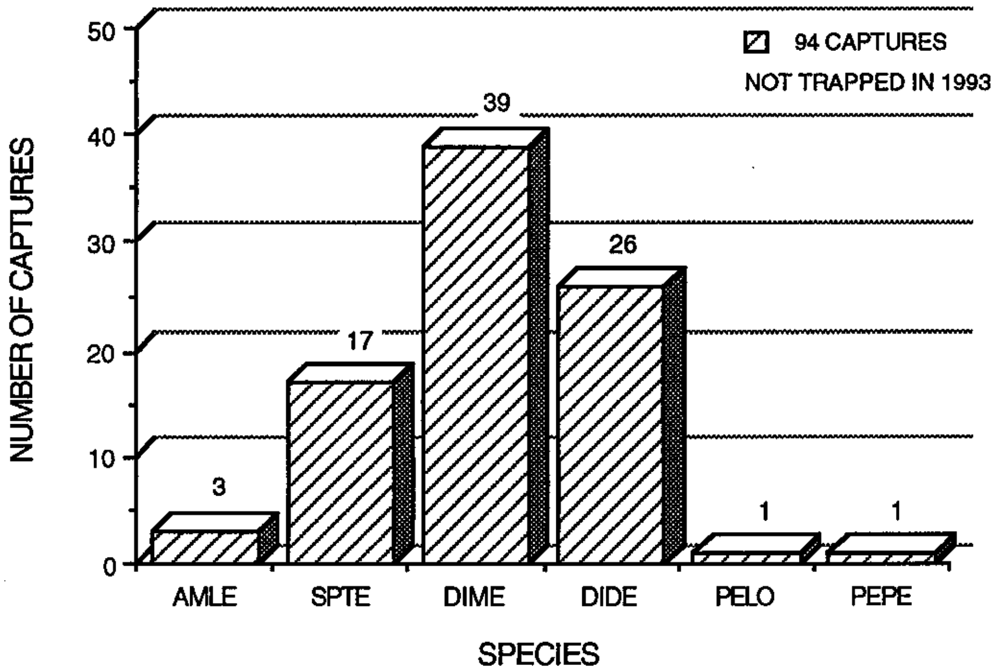
SPMO = *Spermophilus mohavensis* / Mohave ground squirrel
AMLE = *Ammospermophilus leucurus* / Antelope ground squirrel
SPTE = *Spermophilus tereticaudus* / Round-tailed ground squirrel
DIME = *Dipodomys merriami* / Merriam's kangaroo rat
DIPA = *Dipodomys panamintinus* / Panamint Kangaroo rat
DIMI = *Dipodomys microps* / Great Basin Kangaroo rat
DIDE = *Dipodomys deserti* / Desert kangaroo rat
PELO = *Perognathus longimembris* / Little pocket mouse
PEPE = *Perognathus penicillatus* / Desert pocket mouse
CHFO = *Chaetodipus formosus* / Long-tailed pocket mouse
NELE = *Neotoma lepida* / Desert woodrat
PEMA = *Peromyscus maniculatus* / Deer mouse
PEER = *Peromyscus eremicus* / Cactus mouse
PECR = *Peromyscus crinitus* / Canyon mouse
PEBO = *Peromyscus boylii* / Brush mouse
PETR = *Peromyscus truei* / Pinyon mouse
ONTO = *Onychomys torridus* / Grasshopper mouse
SYAU = *Sylvilagus audubonii* / Audubon cottontail

GRAPH 10. CAPTURES FROM BITTER SPRINGS UNIT BSCRE GRID.



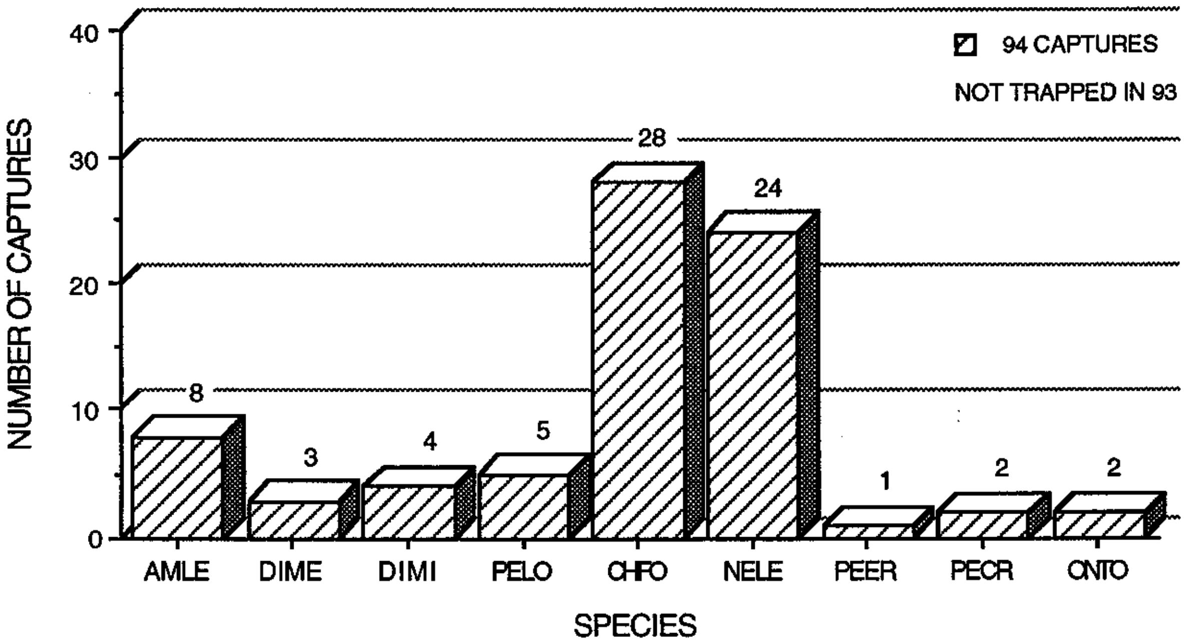
SPMO = *Spermophilus mohavensis* / Mohave ground squirrel
AMLE = *Ammospermophilus leucurus* / Antelope ground squirrel
SPTE = *Spermophilus tereticaudus* / Round-tailed ground squirrel
DIME = *Dipodomys merriami* / Merriam's kangaroo rat
DIPA = *Dipodomys panamintinus* / Panamint Kangaroo rat
DIMI = *Dipodomys microps* / Great Basin Kangaroo rat
DIDE = *Dipodomys deserti* / Desert kangaroo rat
PELO = *Perognathus longimembris* / Little pocket mouse
PEPE = *Perognathus penicillatus* / Desert pocket mouse
CHFO = *Chaetodipus formosus* / Long-tailed pocket mouse
NELE = *Neotoma lepida* / Desert woodrat
PEMA = *Peromyscus maniculatus* / Deer mouse
PEER = *Peromyscus eremicus* / Cactus mouse
PECR = *Peromyscus crinitus* / Canyon mouse
PEBO = *Peromyscus boylii* / Brush mouse
PETR = *Peromyscus truei* / Pinyon mouse
ONTO = *Onychomys torridus* / Grasshopper mouse
SYAU = *Sylvilagus audubonii* / Audubon cottontail

GRAPH 11. CAPTURES FROM BITER SPRINGS UNIT BSDCRE GRID.



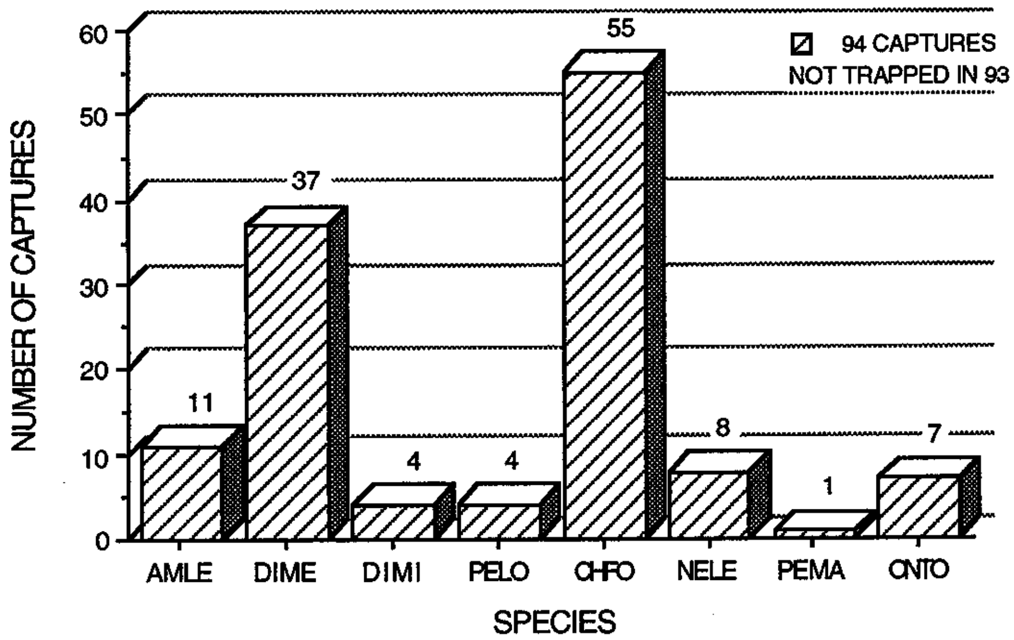
SPMO = *Spermophilus mohavensis* / Mohave ground squirrel
AMLE = *Ammospermophilus leucurus* / Antelope ground squirrel
SPTE = *Spermophilus tereticaudus* / Round-tailed ground squirrel
DIME = *Dipodomys merriami* / Merriam's kangaroo rat
DIPA = *Dipodomys panamintinus* / Panamint Kangaroo rat
DIMI = *Dipodomys microps* / Great Basin Kangaroo rat
DIDE = *Dipodomys deserti* / Desert kangaroo rat
PELO = *Perognathus longimembris* / Little pocket mouse
PEPE = *Perognathus penicillatus* / Desert pocket mouse
CHFO = *Chaetodipus formosus* / Long-tailed pocket mouse
NELE = *Neotoma lepida* / Desert woodrat
PEMA = *Peromyscus maniculatus* / Deer mouse
PEER = *Peromyscus eremicus* / Cactus mouse
PECR = *Peromyscus crinitus* / Canyon mouse
PEBO = *Peromyscus boylii* / Brush mouse
PETR = *Peromyscus truei* / Pinyon mouse
ONTO = *Onychomys torridus* / Grasshopper mouse
SYAU = *Sylvilagus audubonii* / Audubon cottontail

GRAPH 12. CAPTURES FROM AVAWATZ MOUNTAINS UNIT AVJUN GRID.



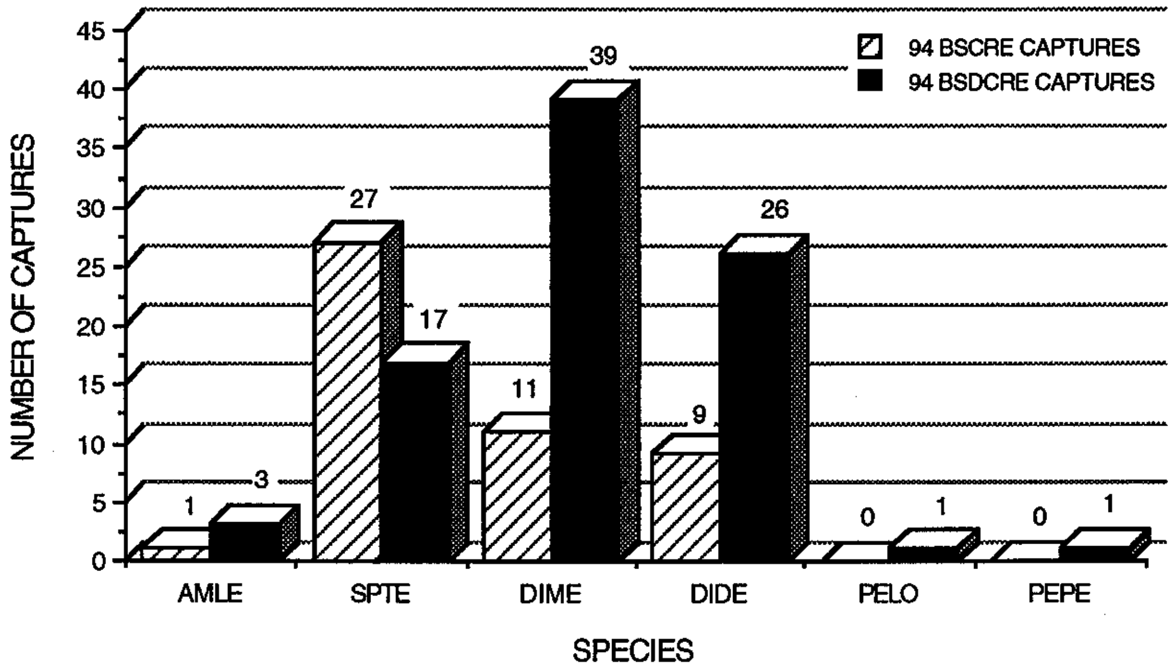
SPMO = *Spermophilus mohavensis* / Mohave ground squirrel
AMLE = *Ammospermophilus leucurus* / Antelope ground squirrel
SPTE = *Spermophilus tereticaudus* / Round-tailed ground squirrel
DIME = *Dipodomys merriami* / Merriam's kangaroo rat
DIPA = *Dipodomys panamintinus* / Panamint Kangaroo rat
DIMI = *Dipodomys microps* / Great Basin Kangaroo rat
DIDE = *Dipodomys deserti* / Desert kangaroo rat
PELO = *Perognathus longimembris* / Little pocket mouse
PEPE = *Perognathus penicillatus* / Desert pocket mouse
CHFO = *Chaetodipus formosus* / Long-tailed pocket mouse
NELE = *Neotoma lepida* / Desert woodrat
PEMA = *Peromyscus maniculatus* / Deer mouse
PEER = *Peromyscus eremicus* / Cactus mouse
PECR = *Peromyscus crinitus* / Canyon mouse
PEBO = *Peromyscus boylii* / Brush mouse
PETR = *Peromyscus truei* / Pinyon mouse
ONTO = *Onychomys torridus* / Grasshopper mouse
SYAU = *Sylvilagus audubonii* / Audubon cottontail

GRAPH 13. CAPTURES FROM AVAWATZ MOUNTAINS UNIT AVCRE GRID.



SPMO = *Spermophilus mohavensis* / Mohave ground squirrel
AMLE = *Ammospermophilus leucurus* / Antelope ground squirrel
SPTE = *Spermophilus tereticaudus* / Round-tailed ground squirrel
DIME = *Dipodomys merriami* / Merriam's kangaroo rat
DIPA = *Dipodomys panamintinus* / Panamint Kangaroo rat
DIMI = *Dipodomys microps* / Great Basin Kangaroo rat
DIDE = *Dipodomys deserti* / Desert kangaroo rat
PELO = *Perognathus longimembris* / Little pocket mouse
PEPE = *Perognathus penicillatus* / Desert pocket mouse
CHFO = *Chaetodipus formosus* / Long-tailed pocket mouse
NELE = *Neotoma lepida* / Desert woodrat
PEMA = *Peromyscus maniculatus* / Deer mouse
PEER = *Peromyscus eremicus* / Cactus mouse
PECR = *Peromyscus crinitus* / Canyon mouse
PEBO = *Peromyscus boylii* / Brush mouse
PETR = *Peromyscus truei* / Pinyon mouse
ONTO = *Onychomys torridus* / Grasshopper mouse
SYAU = *Sylvilagus audubonii* / Audubon cottontail

GRAPH 14. CAPTURES FROM BITTER SPRINGS UNIT GRIDS BSCRE/BSDCRE.



SPMO = *Spermophilus mohavensis* / Mohave ground squirrel
AMLE = *Ammospermophilus leucurus* / Antelope ground squirrel
SPTE = *Spermophilus tereticaudus* / Round-tailed ground squirrel
DIME = *Dipodomys merriami* / Merriam's kangaroo rat
DIPA = *Dipodomys panamintinus* / Panamint Kangaroo rat
DIMI = *Dipodomys microps* / Great Basin Kangaroo rat
DIDE = *Dipodomys deserti* / Desert kangaroo rat
PELO = *Perognathus longimembris* / Little pocket mouse
PEPE = *Perognathus penicillatus* / Desert pocket mouse
CHFO = *Chaetodipus formosus* / Long-Tailed pocket mouse
NELE = *Neotoma lepida* / Desert woodrat
PEMA = *Peromyscus maniculatus* / Deer mouse
PEER = *Peromyscus eremicus* / Cactus mouse
PECR = *Peromyscus crinitus* / Canyon mouse
PEBO = *Peromyscus boylii* / Brush mouse
PETR = *Peromyscus truei* / Pinyon mouse
ONTO = *Onychomys torridus* / Grasshopper mouse
SYAU = *Sylvilagus audubonii* / Audubon cottontail

Table 1. The abundance or absence (-) of small mammal species at the 1994 NTC Ft. Irwin survey sites. The abundance values (rounded to one decimal place) represent the number of new captures per hectare taken from each 4.5 hectare trap grid over the five day trapping period. See MATERIALS AND METHODS-Grid Layout on page 1 for grid details, TABLE OF CONTENTS page iii for grid codes, and RESULTS pages 10-23 for species codes.

GRID	SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	PETR	ONTO	SYAU
LAKE	1.3[1]	6.4	-	9.3	1.1	3.1	-	6.0	-	0.7	-	-	-	-	-	-	0.2	-
PION	-	1.1	-	6.0	2.2	-	-	-	-	20.7	-	-	-	-	-	-	0.2	-
MOCRE	0.2	10.9	-	12.9	6.2	-	-	1.6	-	0.7	1.1	1.1	-	-	-	-	0.9	-
MOROK	-	3.6	-	13.6	2.4	0.2	-	1.3	-	4.0	2.0	0.2	0.2	1.1	-	-	0.4	-
GRACRE	-	2.9	-	2.2	21.6	-	-	-	-	-	-	-	-	-	-	-	0.4	-
GRAHYM	-	1.8	-	0.6	16.9	-	0.2	0.7	-	0.4	0.9	0.2	-	0.4	-	-	0.4	-
GRABLB	-	0.2	-	0.7	12.4	-	-	-	-	0.2	0.2	0.2	-	-	-	-	-	-
BSDUN	-	1.1	5.1	5.1	-	-	8.0	0.4	2.2	0.2	1.4	-	-	-	-	-	-	-
BSALK	-	0.9	3.3	6.2	-	-	1.3	0.7	2.2	0.2	1.1	0.2	1.4	-	-	-	0.2	-
BSCRE	-	0.2	6.0	2.4	-	-	2.0	-	-	-	-	-	-	-	-	-	-	-
BSDCRE	-	0.7	3.8	8.7	-	-	5.8	0.2	0.2	-	-	-	-	-	-	-	-	-
AVJUN	-	1.8	-	0.7	-	0.9	-	1.1	-	6.2	5.3	-	0.2	0.4	-	-	0.4	-
AVCRE	-	2.4	-	8.2	-	0.9	-	0.9	-	12.2	1.8	0.2	-	-	-	-	1.6	-

Discrepancy:[1]=1 new unknown sex adult was caught on Lake grid during the Granite Mountains Unit.

Table 2. The abundance or absence (-) of small mammal species at the 1993 NTC Ft. Irwin survey sites. The abundance values (rounded to one decimal place) represent the number of new captures per hectare taken from each 4.5 hectare trap grid over the five day trapping period. See MATERIALS AND METHODS-Grid Layout on page 1 for grid details, TABLE OF CONTENTS page iii for grid codes, and RESULTS pages 10-23 for species codes.

GRID	SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	PETR	ONTO	SYAU
LAKE	5.3	10.9	-	10.4	4.9	0.4	-	2.2	-	1.1	0.4	-	-	-	-	-	1.1	-
PION	-	4.0	-	1.6	3.1	-	-	-	-	31.3	2.0	-	-	-	-	-	2.7	-
MOCRE	-	6.4	-	13.1	11.3	0.2	-	1.6	-	0.2	7.8	1.8	1.6	-	-	-	5.1	0.2
MOROK	-	4.9	-	10.9	0.4	-	-	0.4	-	4.0	13.8	1.8	3.6	0.2	-	-	0.4	-
MOATR	2.2	12.4	-	7.1	0.7	6.2	-	4.2	-	-	5.3	0.2	0.7	-	2.7	-	1.8	-
ECHROK	-	2.7	-	1.8	1.8	-	-	0.4	-	9.8	15.3	0.4	1.1	1.3	2.0	-	0.9	-
ECHCRE	0.2	1.6	-	11.3	1.3	-	-	10.4	-	0.2	2.0	0.4	1.1	1.8	2.9	-	5.1	-
GRACRE	-	12.0	-	-	34.7	0.4	-	0.2	-	-	4.9	1.6	0.4	-	-	-	2.4	-
GRAHYM	0.2	17.1	-	-	35.8	0.7	-	-	-	-	5.3	1.6	0.4	-	-	-	1.6	-
GRABLB	0.4	13.8	-	-	26.0	1.3	-	-	-	1.3	6.7	0.7	-	-	-	-	2.2	-
BSROK	-	0.9	0.9	4.2	-	-	-	-	-	21.6	6.0	-	0.7	2.9	1.1	-	-	-
BSDUN	-	-	8.0	2.2	-	-	21.1	0.4	6.9	1.8	2.4	0.2	-	0.4	-	-	-	-
BSALK	-	0.2	2.7	13.3	-	0.2	3.6	0.2	6.9	0.2	2.9	1.6	1.1	-	-	0.7	0.7	0.7
BSCRE	-	0.4	2.9	16.7	-	-	5.6	0.7	1.6	-	-	0.2	-	-	-	-	-	-
MNXROK	-	2.7	-	2.0	-	-	-	-	-	15.1	8.7	-	0.2	2.9	-	-	-	-
MNXCREW	-	4.9	1.6	21.1	-	-	0.4	2.9	0.2	4.4	0.9	-	-	0.2	-	-	1.3	-
MNXGRS	-	4.0	2.2	15.8	-	-	0.4	3.1	-	0.4	0.7	-	-	-	-	-	0.7	-
MNXCREE	-	13.1	11.3	1.6	-	-	0.2	1.8	-	-	1.6	-	-	-	-	-	0.2	-

Table 3. The age and sexual demographics of small mammal species captured at the 1994 NTC survey sites. AM=Adult male, AF=Adult female, JM=Juvenile male, JF=Juvenile female, unk=unknown, juv=juvenile. See MATERIALS AND METHODS-Grid Layout on page 1 for grid details, TABLE OF CONTENTS page iii for grid codes, and RESULTS pages 10-23 for species codes.

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
LAKE	AM	4[1]	9[2]	0	17	0	5	0	12	0	1	0	0	0	0	0	1	0	0
	AF	1	0	0	2	0	2	0	4	0	0	0	0	0	0	0	0	0	0
	JM	0	17	0	22	4	4	0	8	0	2	0	0	0	0	0	0	0	0
	JF	0	2	0	1	1	3	0	3	0	0	0	0	0	0	0	0	0	0
	Total	6	29	0	42	5	14	0	27	0	3	0	0	0	0	0	1	0	0

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
PION	AM	0	3	0	15	6	0	0	0	0	33	0	0	0	0	0	0	0	0
	AF	0	1	0	1	1	0	0	0	0	3	0	0	0	0	0	0	0	0
	JM	0	1	0	11	3	0	0	0	0	54	0	0	0	0	0	1	0	0
	JF	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
	Total	0	5	0	27	10	0	0	0	0	93	0	0	0	0	0	1	0	0

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
MOORE	AM	1	27	0	36	13[3]	0	0	4	0	2	2	4	0	0	0	3	0	0
	AF	0	3	0	2	0	0	0	1	0	0	1	0	0	0	0	0	0	0
	JM	0	18	0	20	12	0	0	1	0	1	2	1	0	0	0	1	0	0
	JF	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0
	Total	1	49	0	58	28	0	0	7	0	3	5	5	0	0	0	4	0	0

Discrepancies: [1]=1 unk sex adult, [2]=1 unk sex adult, [3]=2 unk sex/ age.

Table 3. Continued. The age and sexual demographics of small mammal species captured at the 1994 NTC survey sites. AM=Adult male, AF=Adult female, JM=Juvenile male, JF=Juvenile female, unk=unknown, juv=juvenile. See MATERIALS AND METHODS-Grid Layout on page 1 for grid details, TABLE OF CONTENTS page iii for grid codes, and RESULTS pages 10-23 for species codes.

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
MOROK	AM	0	6	0	33	4	1	0	3	0	12	2	1	0	2	0	2	0	0
	AF	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0
	JM	0	9	0	26	6	0	0	1	0	6	7	0	1	2	0	0	0	0
	JF	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0
	Total	0	16	0	61	11	1	0	6	0	18	9	1	1	5	0	2	0	0

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
GRACRE	AM	0	4	0	7	37	0	0	0	0	0	0	0	0	0	0	1	0	0
	AF	0	1	0	1	8	0	0	0	0	0	0	0	0	0	0	0	0	0
	JM	0	8	0	2	49	0	0	0	0	0	0	0	0	0	0	0	0	0
	JF	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0
	Total	0	13	0	10	97	0	0	0	0	0	0	0	0	0	0	2	0	0

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
GRAHYM	AM	0	4	0	5	29	0	1	1	0	0	2[4]	1	0	0	0	0	0	0
	AF	0	1	0	1	2	0	0	0	0	1	0	0	0	0	0	0	0	0
	JM	0	3	0	1	41	0	0	2	0	1	0	0	0	2	0	1	0	0
	JF	0	0	0	0	4	0	0	0	0	0	1	0	0	0	0	1	0	0
	Total	0	8	0	7	76	0	1	3	0	2	4	1	0	2	0	2	0	0

Discrepancies: [4]=1 unk sex adult.

Table 3. Continued. The age and sexual demographics of small mammal species captured at the 1994 NTC survey sites. AM=Adult male, AF=Adult female, JM=Juvenile male, JF=Juvenile female, unk=unknown, juv=juvenile. See MATERIALS AND METHODS-Grid Layout on page 1 for grid details, TABLE OF CONTENTS page iii for grid codes, and RESULTS pages 10-23 for species codes.

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
GRABLB	AM	0	0	0	2	16	0	0	0	0	1	1	1	0	0	0	0	0	0
	AF	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
	JM	0	1	0	1	32	0	0	0	0	0	0	0	0	0	0	0	0	0
	JF	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	1	0	3	56	0	0	0	0	1	1	1	0	0	0	0	0	0

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
BSDUN	AM	0	4	7^{5}	12^{6}	0	0	15	1	6	1	0	0	0	0	0	0	0	0
	AF	0	0	1	3	0	0	0	0	1	0	0	0	0	0	0	0	0	0
	JM	0	0	7	7	0	0	21	1	3	0	2	0	0	0	0	0	0	0
	JF	0	1	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	5	23	23	0	0	36	2	10	1	2	0	0	0	0	0	0	0

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
BSALK	AM	0	3	9	19^{7}	0	0	4	3	2^{8}	0	4	1	1	0	0	0	0	0
	AF	0	1	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JM	0	0	4	5	0	0	2	0	5	1	1	0	1	0	0	0	0	0
	JF	0	0	1	1	0	0	0	0	2	0	0	0	0	0	0	1	0	0
	Total	0	4	15	28	0	0	6	3	10	1	5	1	2	0	0	1	0	0

Discrepancies: ^{5}=1 unk sex/age; ^{6}=1 unk sex adult; ^{7}=1 unk sex adult; ^{8}=1 unk sex adult.

Table 3. Continued. The age and sexual demographics of small mammal species captured at the 1994 NTC survey sites. AM=Adult male, AF=Adult female, JM=Juvenile male, JF=Juvenile female, unk=unknown, juv=juvenile. See MATERIALS AND METHODS-Grid Layout on page 1 for grid details, TABLE OF CONTENTS page iii for grid codes, and RESULTS pages 10-23 for species codes.

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
BSCRE	AM	0	1	7	3	0	0	4	0	0	0	0	0	0	0	0	0	0	0
	AF	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
	JM	0	0	17	7	0	0	4	0	0	0	0	0	0	0	0	0	0	0
	JF	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	1	27	11	0	0	9	0	0	0	0	0	0	0	0	0	0	0

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
BSDCRE	AM	0	1	10	18	0	0	17	0	0	0	0	0	0	0	0	0	0	0
	AF	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	JM	0	1	6	18	0	0	9	1	1	0	0	0	0	0	0	0	0	0
	JF	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	3	17	39	0	0	26	1	1	0	0	0	0	0	0	0	0	0

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
AVJUN	AM	0	4	0	2	0	2	0	2	0	12^{9}	13	0	0	1	0	1	0	0
	AF	0	0	0	0	0	0	0	1	0	2	0	0	0	0	0	0	0	0
	JM	0	4	0	1	0	2	0	2	0	13	11	0	1	1	0	1	0	0
	JF	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	8	0	3	0	4	0	5	0	28	24	0	1	2	0	2	0	0

Discrepancies: ^{9}=1 unk sex adult.

Table 3. Continued. The age and sexual demographics of small mammal species captured at the 1994 NTC survey sites. AM=Adult male, AF=Adult female, JM=Juvenile male, JF=Juvenile female, unk=unknown, juv=juvenile. See MATERIALS AND METHODS-Grid Layout on page 1 for grid details, TABLE OF CONTENTS page iii for grid codes, and RESULTS pages 10-23 for species codes.

GRID		SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	ONTO	PETR	SYAU
AVCRE	AM	0	5	0	26	0	1	0	1	0	30	3	1	0	0	0	6	0	0
	AF	0	0	0	2	0	0	0	0	0	4	0	0	0	0	0	0	0	0
	JM	0	6	0	7	0	2	0	3	0	21	5	0	0	0	0	1	0	0
	JF	0	0	0	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Total	0	11	0	37	0	4	0	4	0	55	8	1	0	0	0	7	0	0

Table 4. The age and sexual demographics of Mohave ground squirrels captured at the 1993 and 1994 NTC survey sites. AM=Adult male, AF=Adult female, JM=Juvenile male, JF=Juvenile female, and unk=unknown. See MATERIALS AND METHODS-Grid Layout on page 1 for grid details and TABLE OF CONTENTS page iii for grid codes. In 1993 Lake grid was trapped during Goldstone Unit 1, Goldstone Unit 2, and the Granite Mountains Unit. In 1994 Lake grid was trapped during the Goldstone Unit, Granite Mountains Unit, and the Avawatz Mountains Unit. This extended period of trapping for 15 trap-days (as compared to five days for all other grids) was done to more accurately assess the population size of this grid. Grids Mocre, Echcre, Moatr, Grablb, and Grahym were trapped for 5 trap-days each. The fifteen day totals include the five day data: The increase in Mohave ground squirrel captures between the five day and fifteen day trapping periods for 1993 was 26, whereas in 1994 there were no additional captures.

GRID	LAKE (93)		LAKE (94)		MOCRE (94)	ECHRE (93)	MOATR (93)	GRABLB (93)	GRAHYM (93)
YEAR	5 DAY	15 DAY	5 DAY	15 DAY					
AGE/SEX									
AM	1	8	4[1]	4	1	0	0	0	0
AF	3	9	1	1	0	0	3	0	0
JM	13	20	0	0	0	0	3	1	1
JF	7	13	0	0	0	1	4	1	0
Total	24	50	6	6[2]	1	1	10	2	1

Discrepancies: [1]=1 unk sex adult, [2]=no additional captures for this period.

Table 5. The Tukey test results comparing the difference in number of individuals of each species at the same grids trapped in 1993 and 1994 and the difference in number of individuals of each species trapped at the Bscre (undisturbed) and the Bsdcre (disturbed) creosote grids in 1994 at NTC Ft. Irwin. See MATERIALS AND METHODS-Grid Layout on page 1 for grid details, TABLE OF CONTENTS page iii for grid codes, and RESULTS pages 10-23 for species codes. LEGEND: + =significant (.05 level or greater) increase in abundance from 93 to 94; - =significant (.05 level or greater) decrease in abundance from 93 to 94; * = not captured in 93 and 94; *93 =not captured in 93; *94 =not captured in 94; NS =no significant difference in captures between 93 and 93; CRE+ =significant (.05 level or greater) increase in abundance on the BSCRE grid; DCRE+ =significant (.05 level or greater) increase in abundance on the BSDCRE gird; *CRE =not captured on the BSCRE grid.

GRID	SPMO	AMLE	SPTE	DIME	DIPA	DIMI	DIDE	PELO	PEPE	CHFO	NELE	PEMA	PEER	PECR	PEBO	PETR	ONTO	SYAU
LAKE	-	-	*	NS	-	NS	*	+	*	NS	*94	*	*	*	*	*	NS	*
PION	*	NS	*	+	NS	*	*	*	*	-	*94	*	*	*	*	*	NS	*
MOCRE	*93	+	*	NS	-	*94	*	NS	*	NS	-	NS	*94	*	*	*	-	*94
MOROK	*	NS	*	NS	NS	*93	*	NS	*	NS	-	NS	-	NS	*	*	NS	*
GRACRE	*	-	*	*93	-	*94	*	*94	*	*	*94	*94	*94	*	*	*	NS	*
GRAHYM	*94	-	*	*93	-	*94	*93	*93	*	*93	-	NS	*94	*93	*	*	NS	*
GRABLB	*94	-	*	*93	-	*94	*	*	*	NS	-	NS	*	*	*	*	*94	*
BSDUN	*	*93	-	NS	*	*	-	NS	-	NS	NS	*94	*	*94	*	*	*	*
BSALK	*	NS	NS	-	*94	*	NS	NS	-	NS	NS	NS	NS	*	*	*94	NS	*94
BSCRE	*	NS	+	-	*	*	-	*94	*94	*	*	*94	*	*	*	*	*	*
BSCRE/ BSDCRE	*	*	CRE+	DCRE+	*	*	DCRE+	*CRE	*CRE	*	*	*	*	*	*	*	*	*

Table 6. The rainfall data from Bicycle Lake weather station at the National Training Center, Ft. Irwin. The Bicycle Lake weather station is approximately centrally located in the southern third of the post and therefore does not represent actual rainfall measured on the grids. However, this is this most continuously recorded data available. Numerical values are measurements in inches. Unmeasureable presence of rain, called a trace, is represented by the letter "T" whereas a lack of data is represented by an "-".

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total (in)
1992	0	1.9	2.24	0.12	T	0	0.10	0	T	0.15	0	1.05	5.56
1993	5.4	2.21	0.21	0	0	0.05	0	0	0	T	T	T	7.87
1994	0.08	0.61	0.36	0	0.02	0	T	0	0	0.05	T	-	1.12

DISCUSSION

A total of 1362 new captures and 2590 recaptures of 15 species were recorded from 13 different grids in the survey for 1994-see Table 1 for abundance values and Table 3 for demographics. Proper baiting technique and routine cleaning and recalibration of the traps proved instrumental to the success of this project: Traps were sufficiently sensitive to capture animals weighing 5 grams.

Of the 1362 new captures, 10 are of known species but were not identified as to sex and/or age due to their escape through holes bitten in the handling bags. These 1994 captures compare with a total of 3,368 new individuals (with 4,465 recaptures) of 18 different species captured at 18 sites in 1993 with 3 new individual *Peromyscus* juveniles unidentified as to species and/or sex for the same reasons stated above.

Ten of the 18 sites trapped in 1993 were trapped again in 1994; Lake, Pion, Mocre, Morok, Gracre, Grahym, Grablb, Bsdun, Bsalk, Bscre, and three new sites were added: Bsdcre, Avjun, and Avcre. These ten sites trapped in 1993 (a "wet" year-approximately 7.9 inches of rain) and 1994 (a "dry" year-approximately 1.1 inches of rain-see Table 6) provide a direct comparison of the short-term impact of one year of rainfall on small mammal populations. However, these rainfall measurements were taken at the Bicycle Lake weather station, which, while the most continuously reliable recording station, was some distance from the trapped sites.

Tables 1 and 2 compare abundance values of species at each grid trapped in 1994 and 1993, respectively. Graphs 1-13 compare the number and diversity of captures from grids trapped in 1994 and 1993. Graph 14 compares the number and diversity of captures from grid Bscre, an undisturbed site, to those of Bsdcre, a disturbed site.

The 4-factor ANOVA (Appendix B1-11) simultaneously analyzed the difference in new captures between years (factor A=1993-94), the four trap rows (transect-factor B=trap row A, B, C, D), the five trap days (factor C=T Day), and the species (factor D) for each grid.

The trap day analysis, comparing the number of new captures caught on the first day to each succeeding day up to the fifth day, was done as part of a separate study to examine the efficacy of a five-day sampling regime. The significantly decreasing difference in numbers of new captures between each day from day one through day five demonstrates that by the fifth day the population had been adequately sampled [(see Appendix B1-11, factor T Day (C)].

The trap row analysis, comparing the number of captures in each trap row to the other trap rows, was done as part of a separate study to examine the efficacy of the 25 meter trap row spacing at providing a uniform capture among the rows. Grids Pion, Gracre, Grablb, and Bsdun have no significant difference between trap rows for either 1993 or 1994-see Appendix B2, B5, B7, and B8. Although the value for Bsdun (B8) is significant between years 1993 and 1994, the Tukey test results comparing the trap rows <u>within</u> each year reveals that there is no significant difference between trap rows.

The following grids had a significant difference between trap rows for one year only-see Appendix B1, B3, B4, B6, B9, B10, and B11:
Lake (1994; row B=C=D, row A≠B, C, or D),
Mocre (1993; row A=D, row B=C, rows A or B≠C or D),
Morok (1994; row A=D, row B=C, rows A or B≠C or D),
Grahym (1993; rows B=C=D, A≠B, C, or D)
Bsalk (1994; row B=C=D, row A≠B, C, or D),
Bscre (1993; row B=C=D, row A≠B, C, or D), and,
Bsdcre (1994; B=C, A=D, A≠B or C, D=B or C).

Because no grids show a repetitive yearly pattern of significantly different captures, this suggests that the grids' trap row spacing is adequate and is not skewing the capture data toward any given row.

The tables of Appendix B show that all grids were significantly different in species captures in 1994 when compared to the captures of 1993. Table 5 presents the Tukey multiple range test results of the significance of the individual species number of captures on each grid for the years 1993 and 1994. Analysis of the species changes, arranged by family, is presented below.

Family Sciuridae-Ground Squirrels

Mohave ground squirrel (SPMO): At the 6 sites within the range of the Mohave ground squirrel comparatively trapped in 1993, Mohave ground squirrels were caught on only 2 sites in 1994-see Tables 1, 3, and 4, and Graphs 1 and 3. Lake grid in 1994, a Saltbush site, was still the dominant site of those trapped in 1994 (as it was in 1993) but had a significant reduction in the number of Mohave ground squirrels captured-see Tables 4 and 5. Although Mohave ground squirrels were caught on grids Grahym and Grablb in 1993, no individuals were caught on these grids in 1994.

One individual was caught on grid Mocre in 1994-although none were captured there in 1993. However, Mocre grid is only 1/4 mile south of Moatr grid, on which in 1993, Mohaves were captured (see Table 4) It would not be difficult for squirrels to move the short distance from Moatr grid to Mocre grid. Because grids Mocre, Grahym, and Grablb, lack complete data for both years no Tukey test can be computed.

Antelope ground squirrel (AMLE): At the 10 sites within the range of the Antelope ground squirrel comparatively trapped in 1993, the Antelope ground squirrels were found at all sites trapped in 1994-see Tables 1 and 3, and Graphs 1-13).

The Antelope ground squirrel shows a significant increase on grid Mocre, significant decreases on grids Lake, Gracre, Grahym, and Grablb, non-significant differences on grids Pion, Morok, Bsalk, Bscre, and on grid Bsdun, insufficient data for analysis-see Table 5. The overall number of individuals captured in 1994, when grids trapped in both 1993 and 1994 are compared, are significantly less (Chi Square,1 df,=72.6=P>0.001)-see Graphs 1-10.

The comparative data in 1994 for the seven grids of Goldstone and Granite Mountains, which are within the known range of both the Mohave and Antelope ground squirrels, show 153 Antelope ground squirrels captured to 6 Mohaves for a ratio of about 26 to 1. In 1993 the numbers for these same grids were 307 AMLE'S to 27 SPMO's for a ratio of about 11 to 1. The 1994 survey results show a ratio of AMLE to SPMO that is approximately 2 times higher than for 1993. Although 2 sites, on which a small number Mohave and a larger number of Antelope ground squirrels were captured in

1993, were not surveyed in 1994, this is most likely a minor component of the explanation (see Tables 1 and 2) for the reduced numbers of individuals of these species.

A dramatic reduction of rainfall is known to negatively impact the population of many desert animals by reducing productivity and thus food. This is true for both the Antelope and Mohave ground squirrels although in different ways. The Antelope ground squirrel, which does not use a seasonal dormancy and remains above ground throughout the year, must continuously find food to survive. Reduced food availability in winter will negatively affect this squirrel population. The Mohave ground squirrel, however, is known to use brown fat to survive underground during the periods of seasonal torpor. The use of brown fat permits the Mohave ground squirrel to survive throughout the winter without having to actively seek food.

If, because of low rainfall, the acquisition of food for conversion to brown fat is not sufficient, Mohave ground squirrels will not survive this period of torpor. The acquisition of food in preparation for aestivation and hibernation is so crucial to the survival of this species that the squirrels, in years of low rainfall/productivity, forgo reproduction to conserve energy. When they do this they also enter the aestivation cycle much earlier, sometimes in early May. Thus the population of Mohave ground squirrels, as surveyed in 1994 (see Tables 1-4, Graphs 1 and 3), may be smaller due to both the failure of the squirrels to reproduce (no juveniles were caught) as well as the potential failure to accurately sample the population due to their early entrance into aestivation.

Round-tailed ground squirrel (SPTE): This squirrel was found on 4 sites in 1994 (Table 1, 3), 3 of which were trapped in 1993; Bsdun, Bsalk, and Bscre (Table 2), and one (Bsdcre) which was new for this year (Graphs 8-10 and 11, respectively). Bsdun, Bscre, and Bsdcre grids, are very sandy sites with the first two having dunes and Bsalk having fine sandy sediments especially on the eastern part-see Grid Descriptions. The Round-tailed squirrels, when compared to 1993, significantly increased in numbers on grids Bscre, significantly decreased in numbers on Bsdun, and increased insignificantly on grid Bsalk-see Tables 1-2 and Table 5.

The comparative data in 1994 for the four grids Bsdun, Bsalk, Bscre, and Bsdcre of the Bitter Springs Unit, which are within the known range of both the Round-tailed and Antelope ground squirrels, show captures of 82 Round-tailed ground squirrels to 13 Antelope ground squirrels for a ratio of 6 to 1. In 1993 the numbers for these same grids (minus Bsdcre) were 61 SPTE's to 3 AMLE's for a ratio of 20 to 1.

The 1993 data, with a different set of grid sites-see Tables 1 and 2, showed an approximate 1:1 ratio. This ratio was thought to be somewhat misleading because the capture data were differentially skewed: The Antelope ground squirrel was favored at the Mannix sites (90:30) with the Round-tailed ground squirrel more numerous at Bitter Springs (65:7). These grids were some distance apart. In 1994, the four grids on which SPTE's were found were of the same unit (Bitter Springs) and therefore relatively close together (see Grid Descriptions; Appendix A3. There were no grids shared by Round-tailed and Mohave ground squirrels.

Family Heteromyidae- Subfamily Dipodomyinae-Kangaroo Rats
Four species of kangaroo rats were captured in 1994: Listed in order of decreasing size-the Desert (DIDE), the Panamint (DIPA), the Great Basin (DIMI), and the Merriam (DIME) kangaroo rat.

Desert kangaroo rat (DIDE): The Desert kangaroo rat was found on 5 grids in 1994 (Tables 1 and 3). Three of these grids were of the 10 grids comparatively trapped in 1993-Bsdun, Bsalk, and Bscre (Graphs 8-10), and two were new grids. Of these new grids, 1 was new for 1994 (Bsdcre- a disturbed site-see Graph 11) and 1 was a grid also trapped in 1993 (Grahym-see Graph 6). Primarily a sand dune dweller, the Desert kangaroo rat was the most abundant species on the dunes of the Bsdun grid but was also very abundant on the incipient dunes of Bsdcre grid.

In 1994, the Desert kangaroo rat decreased significantly on the sandy grids of Bsdun and Bscre, decreased insignificantly on grid Bsalk, with insufficient data for analysis on grid Grahym, when compared to 1993 data (Table 5). This species was the most successful kangaroo rat at exploiting the dune environment in 1993: There were 10 times more of this species as the nearest kangaroo rat competitor-the Merriam kangaroo rat-on Bsdun but on Bscre with its incipient dunes, the ratio reversed:

Three Merriam kangaroo rats for every Desert kangaroo rat. In 1994, while still the most successful dune species, DIDE was captured only 1.5 times as much as the Merriam kangaroo rat on Bsdun with Bscre showing approximately a 1 to 1 ratio between these two species (see Tables 1 and 2). This dramatic change in proportion of the species suggests a seed availability in dry years that favors the foraging strategy of a Merriam-sized kangaroo rat.

Panamint kangaroo rat (DIPA): This species was found at all Goldstone and Granite Mountains grids (Graphs 1-7) although at significantly reduced numbers on grids Lake, Mocre, Gracre, Grahym, and Grablb and insignificantly increased and decreased at grids Morok and Pion, respectively, when compared with 1993 captures (see Tables 1, 2, and 5). It was most abundant at all three of the Granite Mountains' grids (as it also was in 1993). Of The Goldstone grids, Morok was of particular interest due to the increase of Panamint individuals captured as compared to 1993. Morok grid is on a rocky lava outcrop-see Grid Descriptions-which, because of its diverse structure, may capture water or seeds that are more favorable to the Panamint kangaroo rat.

Great Basin kangaroo rat (DIMI): This species, at the southwestern portion of its range at NTC, was never very abundant. It was found on 4 grids (Graphs 1, 4, 12, and 13) in 1994 (two of which, Lake and Morok, were of the 10 sites comparatively trapped in 1993) and was most abundant in the Saltbushes of the Lake grid falling just short of being a significant increase 1994 (see Tables 1, 2, and 5). This species was captured on grids Gracre, Grahym, Grablb, and Bsalk in 1993, but not 1994, and therefore, although a decrease which should be noted, no statistical comparison can be made of these grids due to insufficient data.

The Great Basin kangaroo rat is a species which does not feed on seeds (as do other the kangaroo rat species). Rather it uses its special chisel-like incisors (it is sometimes called the Chisel-toothed kangaroo rat) to strip the outer layers of vegetation containing the succulent tissues it seeks. These tissues are also desired by the Mohave and Antelope ground squirrels whose captures were much lower in 1994. Perhaps the reduction of the squirrels' population reduced interspecific competition for food permitting the kangaroo rat to increase.

Merriam kangaroo rat (DIME): This was the most widespread species, being found on all sites in 1994 (Graphs 1-13) as compared to 1993 where it was absent from the Granite Mountains grids (Gracre, Grahym, and Grablb-see Tables 1 and 2). In 1994, this species increased significantly on grid Pion, decreased significantly on grids Bsalk and Bscre, insignificantly increased on grids Morok and Bsdun, insignificantly decreased on grids Lake and Mocre, and on grids Gracre, Grahym, and Grablb, although an increase which should be noted, no statistical comparison can be made of these grids due to insufficient data for analysis-see Table 5.

The first time captures in 1994 on grids Gracre, Grahym, and Grablb, suggest that reduced rainfall in 1994 affected seed productivity by reducing the larger sized or specific species of seed preferred by the Panamint kangaroo rat. This reduction in preferred seed would probably lead to a shift in seed availability more favorable to the smallest of the kangaroo rats. Additionally, with reduced numbers of the larger Panamint kangaroo rat there would be reduced interspecific competition for food or fewer interspecific agonistic encounters between these two species potentially permitting the smaller Merriam kangaroo rat to successfully invade these grids. No other species surveyed showed this kind of sustainability in 1994.

Family Heteromyidae- Subfamily Perognathinae-Pocket Mice
Three species of pocket mice were captured in 1994: Listed in order of decreasing size-the Desert (PEPE), the Long-tailed (CHFO), and the Little (PELO) pocket mouse.

Desert pocket mouse (PEPE): This pocket prefers sandy substrates and within its range replaces the Long-tailed pocket mouse in such habitats. The Desert pocket mouse was found on three grids in 1994: Two of which (Bsdun and Bsalk) were of the 10 grids comparatively trapped in 1993-see Tables 1 and 2, and Graphs 8 and 9-and one of which was new (Bsdcre)-see Table 3 and Graph 11. Not very abundant in 1994, the captures of this species, as compared with 1993, significantly decreased on grids Bsdun and Bsalk, or disappeared (Bscre)-see Table 5. Of interest, the captures on Bsdun and Bsalk were essentially equal to each other in 1993 and again in 1994, although their captures were fewer in the latter year.

Long-Tailed pocket mouse (CHFO): The most widespread species in 1994, the Long-Tailed pocket mouse was most abundant on desert pavement and other coarse sediment substrates. Captured on 10 grids in 1994 (8 of which were of the 10 sites comparatively trapped in 1993-see Graphs 1-4, 6-9) it was also found on 2 new grid sites-Avjun and Avcre (see Table 3, Graphs 12, 13). Pion grid of the Goldstone unit had the most captures of any grid for both 1994 and 1993: Although this year the captures were significantly fewer by one-third (see Tables 1, 2, and 5).

The captures of this species in 1994, as compared with 1993, insignificantly increased on grid Mocre, remained the same on grids Morok and Bsalk, insignificantly decreased on grids Lake, Grablb, and Bsdun, or, as in 1993, were not recorded (Gracre, Bscre)-see Tables 1, 2, and 5). Although CHFO was captured at Grahym in 1994, a lack of captures in 1993 prevents statistical comparison between the two years for this grid.

Little pocket mouse (PELO): This species, which prefers gravelly substrates, was found on nine grids in 1994 (6 of which were of the 10 sites comparatively trapped in 1993-see Tables 1 and 2 and Graphs 1, 3, 4, 6, 8, 9) three of which were new-Bsdcre, Avjun, and Avcre-see Graphs 11-13). The captures of this species in 1994, as compared with 1993, significantly increased on Lake grid, appeared on grid Grahym, had no significant differences on Mocre, Morok, Bsdun, and Bsalk, and were not recorded on grids Gracre and Bscre.

The significant increase in the captures of this species on Lake grid in 1994 may be related to the concomitant significant reduction (as compared to 1993) of the Mohave and Antelope ground squirrels and the Panamint Kangaroo rat. It may be that a dryer year favors this pocket mouse either physiologically (due to its more water conserving kidney), or nutritionally (favored food species being differentially selected for), or behaviorally (fewer interspecific agonistic interactions with the much larger and aggressive Panamint kangaroo rat). Although the numbers of the Grasshopper mouse (ONTO) were insignificantly fewer in 1994 (one versus five-see Graph 1 and Table 5) this mouse, whose home range may be up to five hectares, is a known predator of the Little pocket mouse and its reduction may be a component in the success of the Little pocket mouse.

Family Cricetidae-SubFamily Cricetinae-New World Rats and Mice
Five species of cricetine mice were captured (as compared to 7 in 1993-see Tables 1-3); the Desert wood rat, (NELE), the Grasshopper mouse, (ONTO), the Deer mouse, (PEMA), the Cactus mouse, (PEER), and the Canyon mouse, (PECR).

Desert woodrat (NELE): The woodrat was found on nine sites in 1994 (6 of which were of the 10 sites comparatively trapped in 1993-see Tables 1 and 2, Graphs 3, 4, 6-9, 12, and 13). This is a species which prefers succulent vegetation and rocky areas: The greatest abundance was found on the more rocky grids Morok and Avjun (see Graphs 4 and 12) although it was also present on the dune site, Bsdun-see Graph 8.

The preference of this species for rocky habitats in 1993 may be seen by the number of captures at grid Echrok (Table 2) and the very significant difference in captures between two proximate grids of different substrate: Morok and Mocre-see Grid Descriptions, Graphs 3 and 4, and Table 5. Morok may be a local "center" from which the woodrats, during years of increasing population pressure, emigrate to the surrounding areas. Although not significantly different due to small sample size in 1994, Morok grid had more than twice the captures of Mocre.

The impact of the reduced rainfall on this species in 1994 may be seen in the significant decrease in captures on grids Morok, Mocre, Grahym, and Grablb, insignificant decreases on grids Bsdun and Bsalk, and lack of captures on grids Lake, Pion, and Gracre.

The absence of woodrats in 1993 and 1994 from the Bscre and Bsdcre grids, which were very sandy with the former having some incipient dunes forming, was possibly due to the reduced annual crop and relatively widespaced perennials. The Desert woodrat has a relatively small foraging range which includes succulent vegetation. The widespread "dryer" vegetation of Bscre grid may require foraging distances which are not energetically cost effective. By comparison, the Bsdun site had extensive crops of Russian thistle and Saltbushes, which were quite close together and even when appear "dry" actually contain much water. The increased density and water content of the vegetation may be sufficient to permit survival.

Grasshopper mouse (ONTO): This facultatively carnivorous species, was the most widely distributed of the cricetine mice having been captured in 1994 on 9 of the 10 sites comparatively trapped in 1993-see Tables 1 and 2, Graphs 1-6, 9, 12, 13.

Preferring coarse sandy or fine to coarse gravel substrates with Creosote Bushes and other perennial shrubs, this species was not particularly abundant anywhere with significantly decreased captures on grid Mocre, insignificant decreases on grids Lake, Pion, Gracre, Grahym, and Bsalk, equal captures on grid Morok, and no captures on grid Grablb (Table 3, 5). It was also absent from Bscre and Bsdun as it was in 1993 and Bsdcre (see Tables 1 and 2). In 1993, it was present in greater numbers on the comparatively trapped grids than other cricetine mice (with the exception of Morok where it stayed the same).

Facultative carnivory may provide the Grasshopper mouse with a broader food choice and therefore a more successful foraging strategy in dryer years than the more herbivorous diet of its relatives.

The Deer mouse group [the Deer mouse (PEMA), the Cactus mouse (PEER), the Canyon mouse (PECR)] present a very complex, very subtle, not well understood picture of niche diversity. None of these mice were very abundant anywhere (see Tables 1 and 2).

Deer mouse (PEMA): This most widely distributed species of the cricetine mice, being found in all terrestrial habitats throughout California, was captured on 6 sites in 1994 (5 of which were comparatively trapped in 1993) as compared to being captured on 11 sites in 1993 (8 of which were comparatively trapped in 1994)-see Tables 1 and 2, Graphs 3, 4, 6, 7, 9, and 13. The Deer mouse insignificantly decreased in captures on grids Mocre, Morok, Grahym, Grablb, and Bsalk, and was not captured at grids Gracre, Bsdun, and Bscre in 1994-see Table 5. Thus the distribution and numbers of individuals of this species captured in 1994 (as compared to 1993) were reduced. This mouse was captured on the Avcre grid but not on the Avjun grid.

Cactus mouse (PEER): This mouse was captured on only 3 grids in 1994 (2 of which were comparatively trapped in 1993) see Graphs 4, 9, and 12 as compared to 10 sites in 1993 (5 of which were comparatively trapped in 1994). The Cactus mouse significantly decreased in captures on grid Morok, insignificantly decreased in captures on grid Bsalk, and was not captured on grids Mocre, Gracre, and Grahym-see Tables 1-3 and 5. It was not captured at Grablb, Bsdun, and Bscre grids in 1993 or 1994. Thus the number of grids and the number of individuals of this species captured in 1994 were reduced (as compared to 1993).

Canyon mouse (PECR): This species, which generally prefers more rocky and gravelly habitats than the Cactus mouse (PEER), was also captured on only 3 grids in 1994 (2 of which were comparatively trapped in 1993) as compared to 7 sites in 1993 (2 of which were comparatively trapped)-see see Tables 1 and 2, and Graphs 4, 6, 12. They increased insignificantly on Morok in 1994, were not captured on Bsdun, and were not captured on Grahym (although they were present in 1993)-see Tables 3 and 5.

Pinyon mouse (PETR): No Pinyon mice were captured in 1994-see Tables 1, 3, and 5.

Family Leporidae-Hares and Rabbits

Audubon cottontail (SYAU): No cottontails were captured in 1994-see Tables 1, 3, and 5.

Comparison of an Undisturbed Site (Bscre) to a Disturbed Site (Bsdcre).

These two grids were trapped to compare the results of training on small mammal species diversity and abundance. Both are sandy creosote habitats about 4.75 kilometers apart (see Appendix A3): However, the Bsdcre grid has been trained on and the Bscre has not. These grids share four species: The Antelope and Round-tailed ground squirrels and the Merriam and Desert Kangaroo rats with two additional species, the Desert and Little pocket mouse, absent from grid Bscre but found on grid Bsdcre (See Table 1 and 3 and Graph 14).

Grid Bsdcre has significantly more Merriam and Desert kangaroo rats and grid Bscre has significantly more Round-tailed ground squirrels. Kangaroo rats feed extensively on seeds and squirrels feed on flowers, vegetative parts, and seeds. It is tempting to suggest that because Bsdcre has been trained on and because the perennials there are reduced in size and quality, that this habitat is better at supporting kangaroo rats than ground squirrels. Grid Bscre, which has mature creosote bushes and few annuals, may support ground squirrels better than kangaroo rats. However, it is not possible to have an accurate assessment of the difference between these two grids because of the lack of diversity and abundance assessment before the training occurred on Bsdcre.

RECOMMENDATIONS

Recommendations for Protection of Sensitive Species Habitat

1. Areas determined as necessary for sensitive species habitat should be posted as such with appropriately prominent signs.

2. A program of education, similar to that used by DyneCorp for range safety, should be enacted to increase the awareness of cadre and rotational troops as to the nature and need of the protection of posted sensitive species habitat. This program should include explanations of destructive acts, how to avoid them, and the philosophical point of view that wildlife and wildlife habitats are as much a part of the resource and heritage of the United States of America as Major Cities, Military Installations, etc., and thus deserve equal protection.

3. Instrumental to any successful program is a well-established chain of command. A successful well-established chain of command is fundamental to, and a hallmark of, the United States Army. If the command structure of Ft. Irwin believes that wildlife and wildlife habitats are a part of the resources and heritage of the United States of America, and thus deserve equal protection, that belief will be translated into policy. That policy will be carried out to the extent of that belief by the appropriate individuals within the established chain of command.

Rehabilitation Techniques

1. Eliminate off-road traffic in designated sensitive areas.

2. Reduce off-road traffic in habitat areas not directly used for training.

3. Maintain corridors of protected habitat throughout the post to facilitate species movement and gene flow which are necessary for

maintenance of species variability and survival.

4. Highly disturbed areas outside of training areas, particularly those with sensitive species, should be rehabilitated by removal of weed species and restoration of soils, followed by an appropriate program of monitoring of regrowth by native vegetation.

5. Wildlife species are dependent upon vegetation. Vegetation is dependent upon rainfall. Therefore, a program of monitoring site-specific rain gauges should be instituted. Accurate knowledge of rainfall would permit better long term monitoring of faunal and floral resources.

Recommendations for Further Study and Management Strategies to Eliminate Potential Threats to Sensitive ecosystems

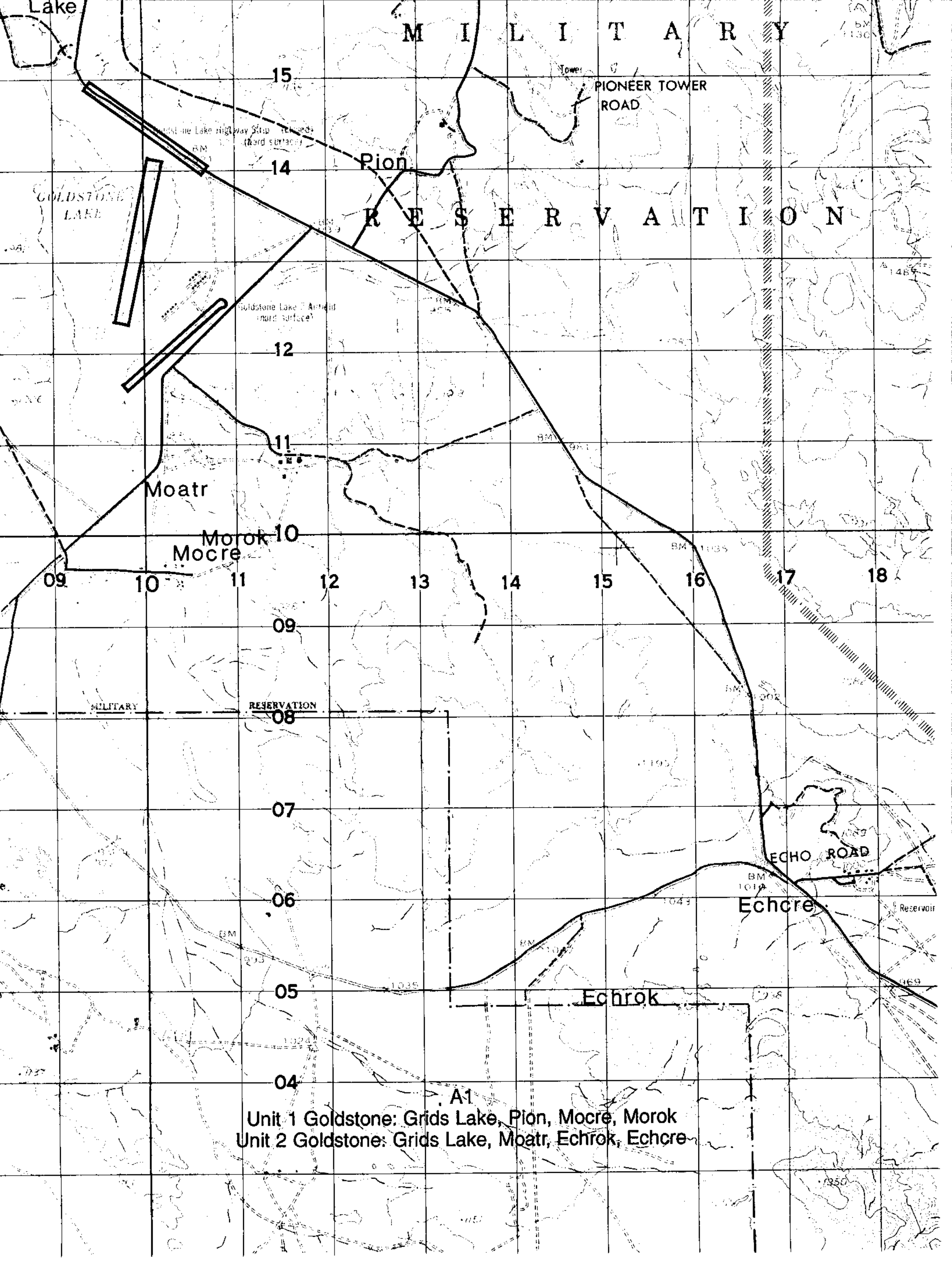
1. Continued study of the selected sites will provide a third year of baseline data of biological resources for these areas.

2. Identification of additional sensitive areas via integration of satellite data and ground truthing.

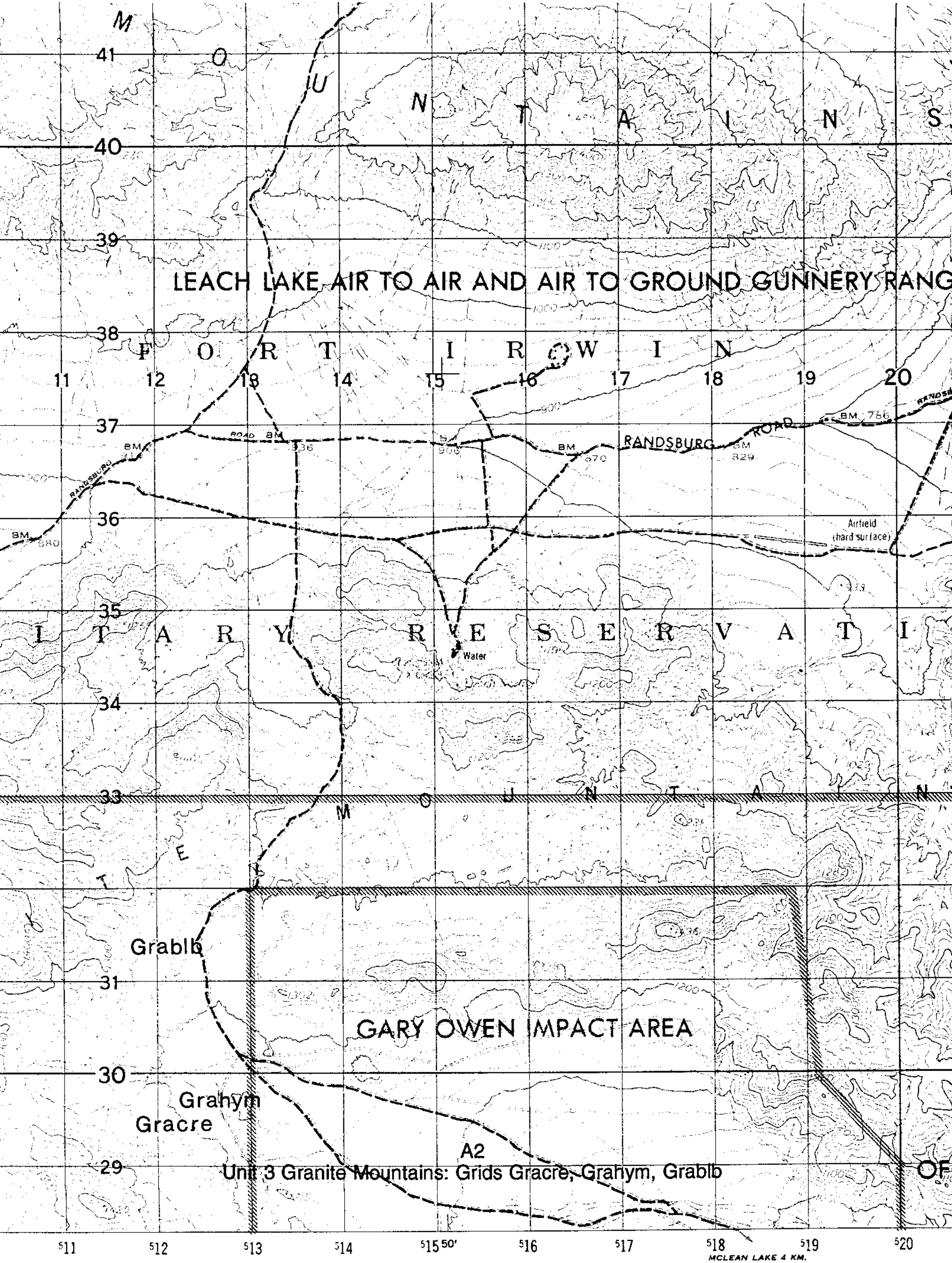
3. Establish experimental areas to permit careful identification of parameters (crushed bushes, vehicle tracks by type, etc.) and quantification of data necessary to determine types and levels of impacts on disturbed areas.

4. Maintenance of habitats in Goldstone Deep Space Communications Complex. The limited access to this area provides a strong measure of protection. Future construction of facilities should minimize damage to surrounding habitat and avoid areas of sensitive species.

5. Establishment of appropriate facilities, near the study sites, to house researchers and their equipment. Facilities near the study sites will enable field crews to remain near study sites to monitor safety of captured animals as sensitive species state protocols require. It will provide increased safety for personnel reduce fuel and vehicle costs.



Unit 1 Goldstone: Grids Lake, Pion, Mocre, Morok
Unit 2 Goldstone: Grids Lake, Moatr, Echrok, Echcre



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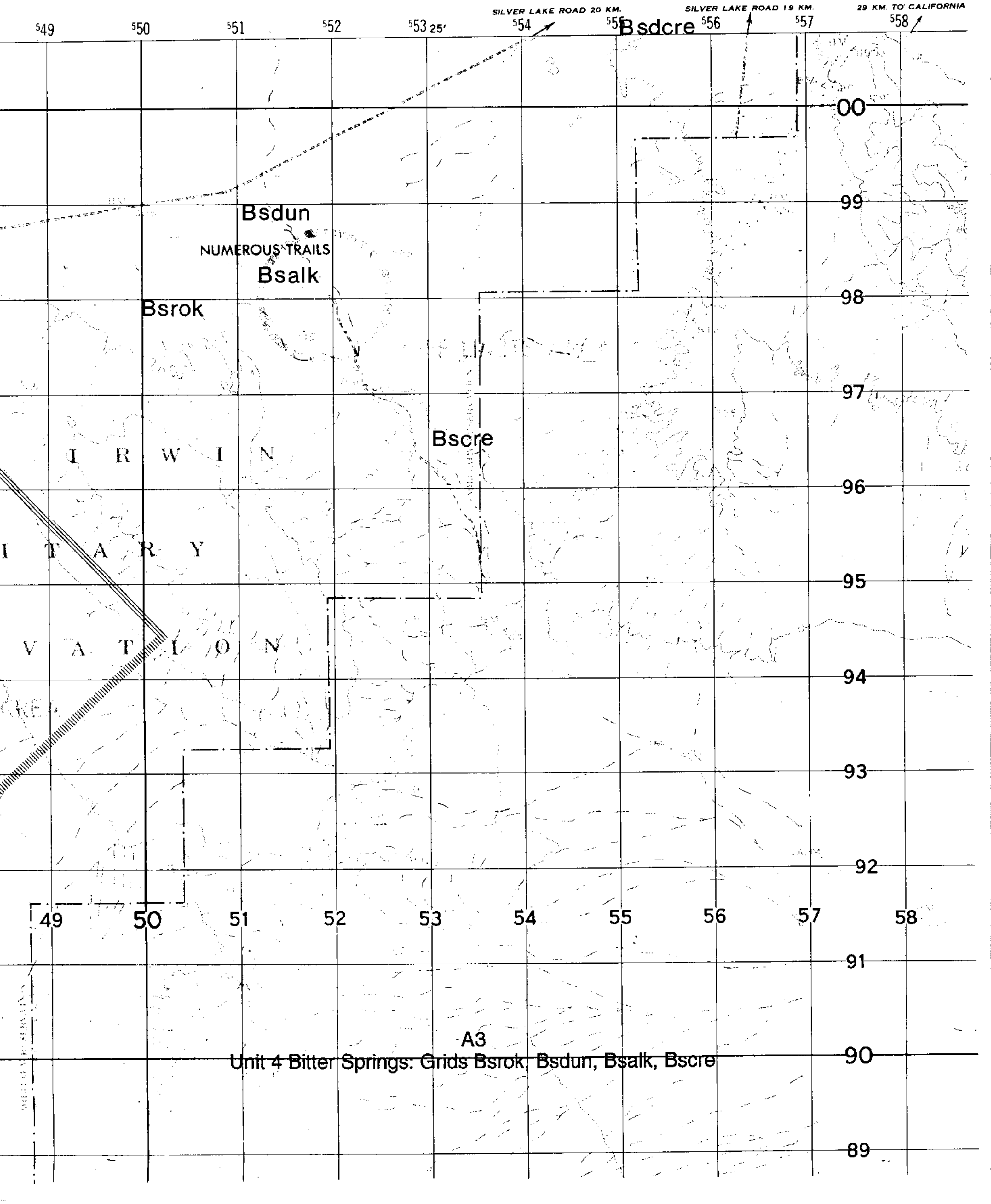
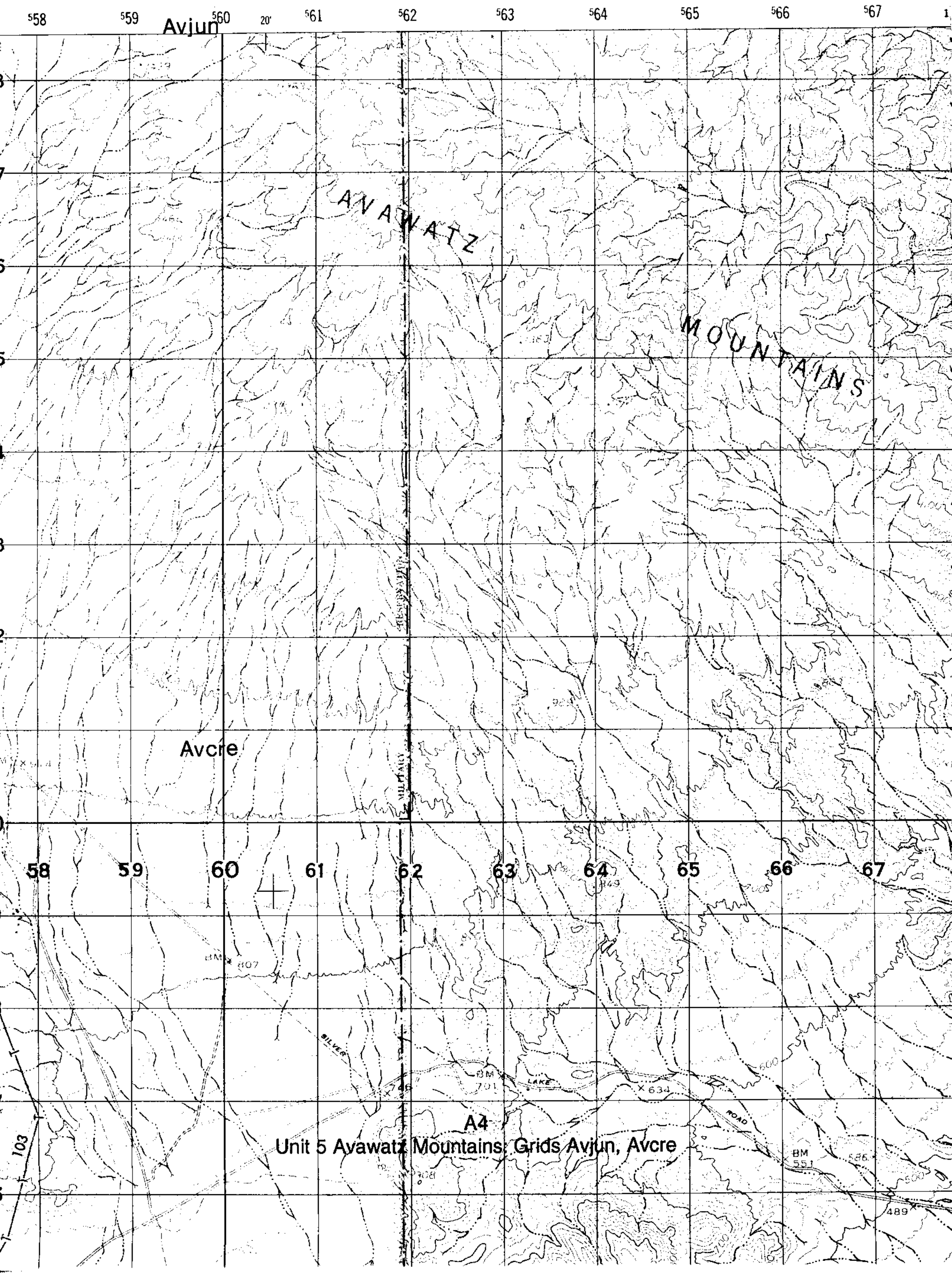
Prepared by the 64th Engineer Detachment (Terrain), Ft. Hood, Texa

FORT IRWIN, CALIFOR
TERRAIN ANALYSIS



A3
Unit 4 Bitter Springs: Grids Bsrok, Bsdun, Bsalk, Bscre



A4
Unit 5 Ayawatz Mountains; Grids Avjun, Avcre

LAKE Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	.207	.207	21.655	.0001
TRANS (B)	3	.123	.041	4.305	.005
AB	3	.023	.008	.797	.4955
T DAY (C)	4	1.976	.494	51.759	.0001
AC	4	.109	.027	2.857	.0227
BC	12	.241	.02	2.103	.0146
ABC	12	.185	.015	1.612	.0826
subjects w. groups	960	9.164	.01		

1

There were no missing cells found.

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	14.35	.844	52.081	.0001
AD	17	2.046	.12	7.427	.0001
BD	51	.948	.019	1.147	.2206
ABD	51	.68	.013	.823	.8121
CD	68	7.276	.107	6.601	.0001
ACD	68	1.083	.016	.983	.5181
BCD	204	4.363	.021	1.32	.0016
ABCD	204	4.127	.02	1.248	.0096
D x subjects w. groups	16320	264.516	.016		

2

There were no missing cells found.

PION Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	.133	.133	12.287	.0005
TRANS (B)	3	.017	.006	.51	.6754
AB	3	.014	.005	.442	.7232
T DAY (C)	4	1.137	.284	26.183	.0001
AC	4	.269	.067	6.184	.0001
BC	12	.065	.005	.497	.9171
ABC	12	.091	.008	.702	.7507
subjects w. groups	960	10.422	.011		

There were no missing cells found.

1

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	23.595	1.388	93.146	.0001
AD	17	21.814	1.283	86.114	.0001
BD	51	.756	.015	.995	.4831
ABD	51	.859	.017	1.13	.2441
CD	68	6.557	.096	6.471	.0001
ACD	68	3.989	.059	3.937	.0001
BCD	204	2.057	.01	.677	.9999
ABCD	204	2.251	.011	.74	.9978
D x subjects w. groups	16320	243.178	.015		

There were no missing cells found.

2

MOCRE Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	.296	.296	27.108	.0001
TRANS (B)	3	.251	.084	7.656	.0001
AB	3	.101	.034	3.071	.0271
T DAY (C)	4	2.903	.726	66.455	.0001
AC	4	.12	.03	2.742	.0275
BC	12	.124	.01	.95	.4961
ABC	12	.325	.027	2.477	.0034
subjects w. groups	960	10.484	.011		

1

There were no missing cells found.

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	18.751	1.103	58.904	.0001
AD	17	2.251	.132	7.071	.0001
BD	51	2.178	.043	2.281	.0001
ABD	51	2.268	.044	2.375	.0001
CD	68	11.455	.168	8.996	.0001
ACD	68	3.338	.049	2.622	.0001
BCD	204	3.582	.018	.938	.7282
ABCD	204	5.081	.025	1.33	.0012
D x subjects w. groups	16320	305.596	.019		

2

There were no missing cells found.

MOROK Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	.168	.168	22.188	.0001
TRANS (B)	3	.037	.012	1.611	.1851
AB	3	.112	.037	4.936	.0021
T DAY (C)	4	3.743	.936	123.55	.0001
AC	4	.054	.014	1.797	.1272
BC	12	.205	.017	2.259	.0081
ABC	12	.142	.012	1.562	.097
subjects w. groups	960	7.271	.008		

There were no missing cells found.

1

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	13.315	.783	54.177	.0001
AD	17	3.439	.202	13.993	.0001
BD	51	2.656	.052	3.603	.0001
ABD	51	1.517	.03	2.057	.0001
CD	68	18.587	.273	18.908	.0001
ACD	68	3.244	.048	3.3	.0001
BCD	204	4.497	.022	1.525	.0001
ABCD	204	2.984	.015	1.012	.4401
D x subjects w. groups	16320	235.929	.014		

There were no missing cells found.

2

GRACRE Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	.983	.983	46.418	.0001
TRANS (B)	3	.027	.009	.429	.7319
AB	3	.097	.032	1.535	.2038
T DAY (C)	4	3.469	.867	40.958	.0001
AC	4	.328	.082	3.874	.004
BC	12	.147	.012	.58	.8592
ABC	12	.384	.032	1.511	.114
subjects w. groups	960	20.324	.021		

1

There were no missing cells found.

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	62.854	3.697	132.419	.0001
AD	17	4.646	.273	9.789	.0001
BD	51	.884	.017	.621	.9847
ABD	51	.653	.013	.459	.9997
CD	68	30.905	.454	16.278	.0001
ACD	68	4.538	.067	2.39	.0001
BCD	204	4.967	.024	.872	.9053
ABCD	204	9.71	.048	1.705	.0001
D x subjects w. groups	16320	455.676	.028		

2

There were no missing cells found.

GRAHYM Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	1.663	1.663	207.72	.0001
TRANS (B)	3	.082	.027	3.412	.017
AB	3	.006	.002	.266	.8499
T DAY (C)	4	3.19	.798	99.637	.0001
AC	4	.361	.09	11.271	.0001
BC	12	.213	.018	2.221	.0093
ABC	12	.227	.019	2.36	.0054
subjects w. groups	960	7.684	.008		

There were no missing cells found.

1

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	55.08	3.24	210.234	.0001
AD	17	10.536	.62	40.216	.0001
BD	51	1.203	.024	1.531	.0088
ABD	51	.935	.018	1.189	.1676
CD	68	38.658	.568	36.888	.0001
ACD	68	4.715	.069	4.499	.0001
BCD	204	3.267	.016	1.039	.3376
ABCD	204	3.257	.016	1.036	.3483
D x subjects w. groups	16320	251.516	.015		

There were no missing cells found.

2

GRABLB Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	1.44	1.44	98.528	.0001
TRANS (B)	3	.004	.001	.085	.9683
AB	3	.033	.011	.744	.5261
T DAY (C)	4	1.185	.296	20.264	.0001
AC	4	.811	.203	13.878	.0001
BC	12	.162	.013	.921	.5249
ABC	12	.308	.026	1.757	.0508
subjects w. groups	960	14.031	.015		

1

There were no missing cells found.

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	32.623	1.919	93.864	.0001
AD	17	5.899	.347	16.973	.0001
BD	51	.465	.009	.446	.9998
ABD	51	.848	.017	.814	.826
CD	68	7.073	.104	5.088	.0001
ACD	68	6.475	.095	4.657	.0001
BCD	204	2.964	.015	.711	.9993
ABCD	204	5.726	.028	1.373	.0004
D x subjects w. groups	16320	333.649	.02		

2

There were no missing cells found.

BSDUN Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	.411	.411	44.51	.0001
TRANS (B)	3	.122	.041	4.405	.0044
AB	3	.009	.003	.329	.8044
T DAY (C)	4	1.593	.398	43.134	.0001
AC	4	.031	.008	.834	.5039
BC	12	.133	.011	1.201	.2774
ABC	12	.278	.023	2.511	.003
subjects w. groups	960	8.862	.009		

1

There were no missing cells found.

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	18.014	1.06	77.751	.0001
AD	17	3.323	.195	14.343	.0001
BD	51	1.456	.029	2.095	.0001
ABD	51	.873	.017	1.256	.1042
CD	68	16.911	.249	18.248	.0001
ACD	68	2.965	.044	3.2	.0001
BCD	204	3.499	.017	1.259	.0076
ABCD	204	4.43	.022	1.593	.0001
D x subjects w. groups	16320	222.418	.014		

2

There were no missing cells found.

BSALK Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	.329	.329	41.462	.0001
TRANS (B)	3	.163	.054	6.851	.0001
AB	3	.017	.006	.697	.554
T DAY (C)	4	1.311	.328	41.266	.0001
AC	4	.076	.019	2.406	.048
BC	12	.189	.016	1.979	.0232
ABC	12	.096	.008	1.012	.4356
subjects w. groups	960	7.627	.008		

1

There were no missing cells found.

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	8.218	.483	41.077	.0001
AD	17	1.414	.083	7.066	.0001
BD	51	.726	.014	1.209	.1461
ABD	51	.676	.013	1.127	.2482
CD	68	7.763	.114	9.701	.0001
ACD	68	.686	.01	.857	.7939
BCD	204	2.657	.013	1.107	.1426
ABCD	204	2.086	.01	.869	.9112
D x subjects w. groups	16320	192.053	.012		

2

There were no missing cells found.

BSCRE Grid-4 Factor ANOVA-Year, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
YEAR (A)	1	.364	.364	51.224	.0001
TRANS (B)	3	.017	.006	.778	.5063
AB	3	.075	.025	3.526	.0146
T DAY (C)	4	.325	.081	11.426	.0001
AC	4	.054	.014	1.901	.1081
BC	12	.048	.004	.563	.8723
ABC	12	.087	.007	1.021	.4263
subjects w. groups	960	6.831	.007		

There were no missing cells found.

1

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	8.334	.49	58.431	.0001
AD	17	4.389	.258	30.768	.0001
BD	51	.682	.013	1.595	.0045
ABD	51	1.12	.022	2.617	.0001
CD	68	3.359	.049	5.887	.0001
ACD	68	2.198	.032	3.852	.0001
BCD	204	1.468	.007	.858	.9294
ABCD	204	1.133	.006	.662	.9999
D x subjects w. groups	16320	136.929	.008		

There were no missing cells found.

2

BSDCRE-BSCRE Grid-4 Factor ANOVA-Grid, Transect, Trap Day, Species

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
GRID (A)	1	.098	.098	20.045	.0001
TRANS (B)	3	.036	.012	2.439	.0631
AB	3	.073	.024	4.985	.002
T DAY (C)	4	.648	.162	33.153	.0001
AC	4	.516	.129	26.381	.0001
BC	12	.153	.013	2.6	.0021
ABC	12	.066	.006	1.131	.3308
subjects w. groups	960	4.693	.005		

1

There were no missing cells found.

Anova table for a 4-factor repeated measures Anova.

Source:	df:	Sum of Squares:	Mean Square:	F-test:	P value:
Repeated Measure (D)	17	4.353	.256	40.327	.0001
AD	17	1.102	.065	10.209	.0001
BD	51	.528	.01	1.631	.003
ABD	51	.535	.01	1.652	.0024
CD	68	5.44	.08	12.598	.0001
ACD	68	4.344	.064	10.061	.0001
BCD	204	1.623	.008	1.253	.0086
ABCD	204	1.226	.006	.946	.6976
D x subjects w. groups	16320	103.627	.006		

2

There were no missing cells found.